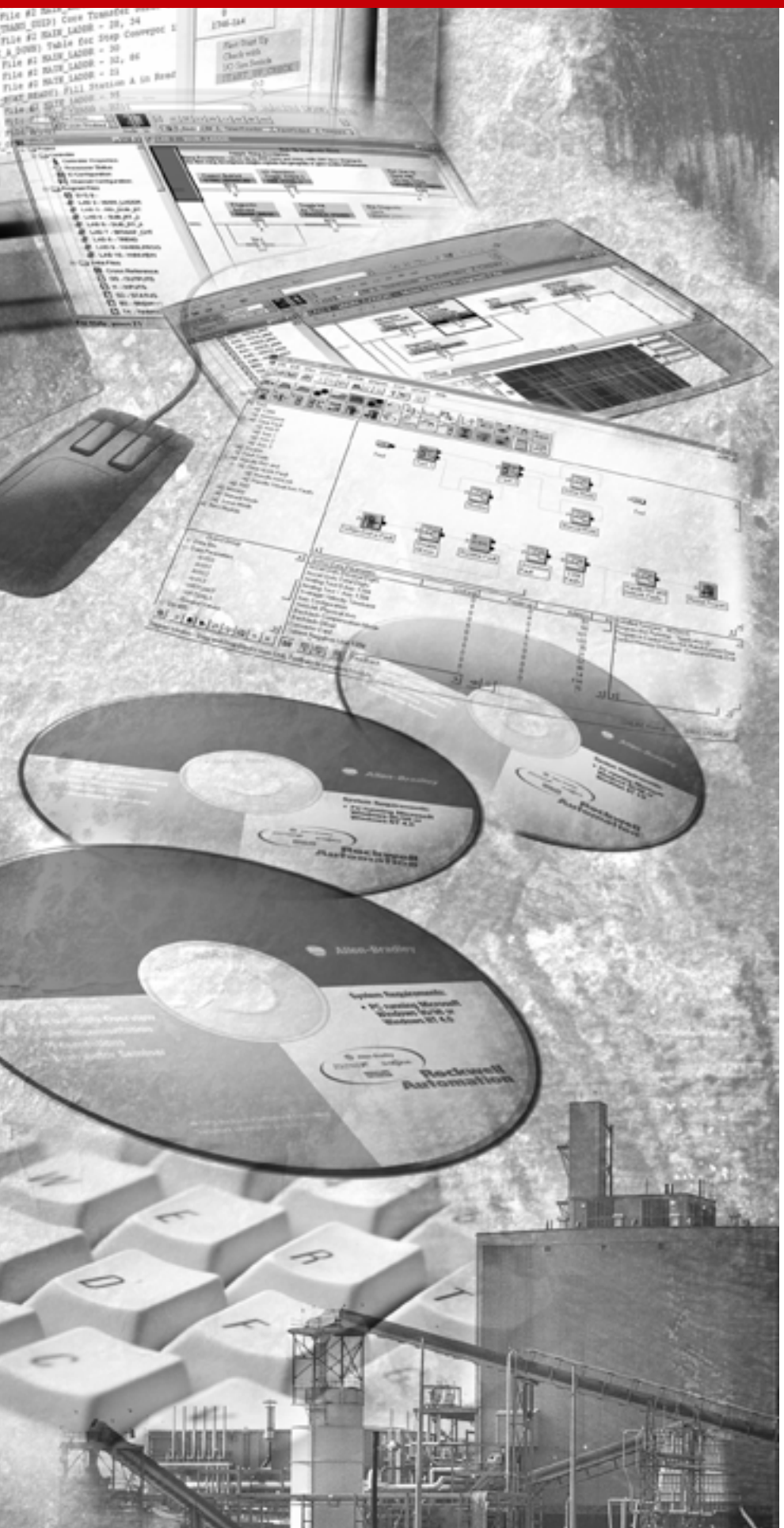

Allen-Bradley

NI-FBUS Configurator

1788-FFCT

User Manual

Rockwell Automation

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This manual gives an overview of fieldbus, describes the NI-FBUS Configurator, and explains how to use the NI-FBUS Configurator. The NI-FBUS Configurator is intended for use with Microsoft Windows NT.

This manual assumes that you are already familiar with Windows NT.

Conventions Used in This Manual

This manual uses the following conventions:

< >	Angle brackets enclose the name of a key on the keyboard—for example, <Enter>.
⇒	The ⇒ symbol leads you through nested menu items and dialog box options to a final action. The sequence File ⇒ Page Setup ⇒ Options directs you to pull down the File menu, select the Page Setup item, and select Options.
bold	Bold text denotes parameters, menus, menu items, buttons or options.
`monospace`	This font denotes the messages and responses that the computer automatically prints to the screen.
italic	Italic text denotes a key concept.
NI-FBUS	In this manual, the term NI-FBUS refers to the NI-FBUS Communications Manager.

Related Documentation

These FOUNDATION Fieldbus Specification documents contain information that you may find helpful as you read this manual:

- System Architecture, document FF-800
- Function Block Application Process, Parts 1–3, documents FF-890, FF-891, and FF-892.

These documents can be purchased from the Fieldbus Foundation as part of the *H1 Communications and User Layer Technical Specification (hardcopy)*. For more information go to http://www.foundationfieldbus.org/ProductsAndServices/FFProductCatalog/ and look under Final Specifications.

Fieldbus Overview

This chapter introduces fieldbus and the parts of a fieldbus network.

This chapter contains fieldbus information that will help you use the NI-FBUS Configurator and solve problems with the configuration of your fieldbus system. Refer to the Glossary for more explanation of fieldbus terms and concepts. If you already have a basic knowledge of fieldbus concepts, or if you want to start using the NI-FBUS Configurator immediately, skip to Chapter 3, NI-FBUS Configurator Overview.

Introduction to Fieldbus

The term *fieldbus* refers to an all-digital, two-way communication system that connects control systems to instrumentation.

The *Fieldbus Foundation* is an organization that developed a fieldbus network based on the work and principles of the ISA and IEC. The goal of the Fieldbus Foundation is to help create products that use a robust industrial network based on existing standards and other proven technologies and to standardize using those sources.

FOUNDATION Fieldbus, the communications network created by the Fieldbus Foundation, is a protocol designed for robust, distributed control in process control environments. Devices connected by FOUNDATION Fieldbus control a process by exchanging data.

Parts of a Fieldbus Network

There are six conceptual parts to a fieldbus network:

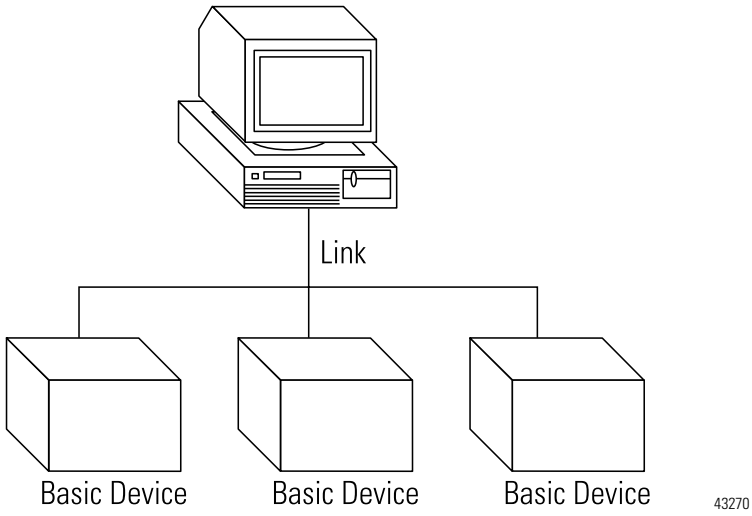
- links
- devices
- blocks and parameters
- linkages
- loops
- schedules

Descriptions of these parts can be found on the following pages.

Links

A FOUNDATION Fieldbus network is made up of devices connected by a serial bus. This serial bus is called a *link*. Links can be separated by special devices called *bridges*. Figure 1.1 shows a link in a fieldbus network.

Figure 1.1 Fieldbus Network Link



Devices

There are three types of devices on a fieldbus network: the *link master*, *basic devices*, and *bridges*.

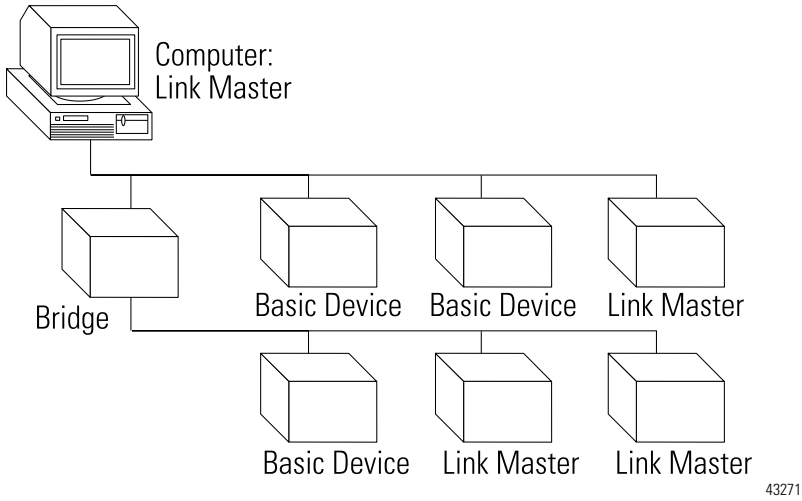
- *Link master* –A link master device controls the communications traffic on a link. A link master prevents multiple devices from communicating data at the same time. A link master can be a Distributed Control System (DCS) or any other device, such as a valve or a pressure transducer. There can be more than one link master per link, but only one link master can be the *Link Active Scheduler (LAS)* at any given time.

- *Basic device* –A basic device cannot become the LAS.

- *Bridge* –A bridge connects two or more links.

Figure 1.2 shows these three types of devices.

Figure 1.2 Fieldbus Network Devices



Identifying Devices

Devices are uniquely identified on the fieldbus network by character string name, or tag. The *device tag* is a configurable attribute of the device that usually describes the type of the device. Device tags are unique to each device on a fieldbus network.

Another unique identifier of a device is the *device ID*, which includes a serial number unique to the device. The device ID is assigned by the device manufacturer; you cannot configure it.

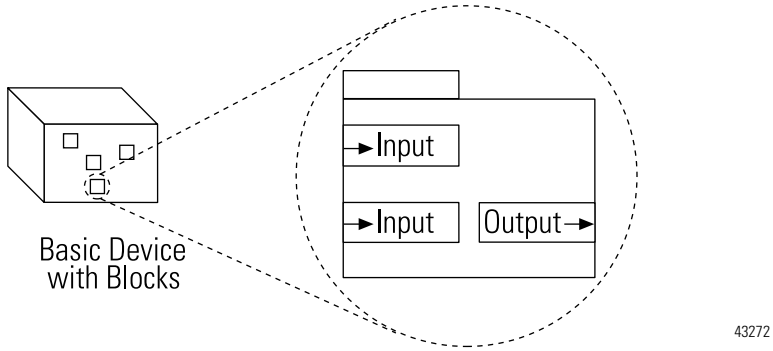
Blocks and Parameters

Functions that can be performed by a device are represented as function blocks. Function blocks contain algorithms and algorithm-controlling parameters. The 10 standard blocks and algorithms include the following:

- Analog Input (AI)
- Analog Output (AO)
- Bias Gain (BG)
- Control Selector (CS)
- Discrete Input (DI)
- Discrete Output (DO)
- Proportional Derivative (PD)
- Proportional Integral Derivative (PID)
- Ratio Control (RC)
- Manual Loader (ML)

You can change or set the action of a block by changing the settings of its parameters. Figure 1.3 shows an example of a function block and its input and output parameters.

Figure 1.3 Function Block Parameters



Function block parameters are classified as follows:

- *Input* parameters receive data from other blocks.
- *Output* parameters send data to other blocks.
- *Contained* parameters do not receive or send data; they are contained within the block.

Function block parameters are also classified as alarm, trend, or tuning parameters. These classifications are independent of the input, output, and contained classifications. For example, an input parameter can also be an alarm, trend, or tuning parameter.

Device Description Files

The vendor supplied Device Description (DD) files describe the function and transducer blocks contained in a device. A DD file includes symbolic information (such as names and help strings) and functional information (such as menus and methods that you can use with the device). DDs are used with the NI-FBUS Configurator to configure a device.

Identifying Blocks

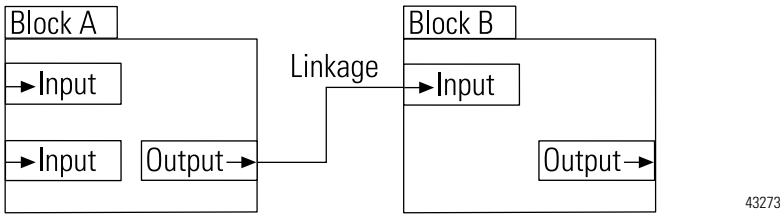
Blocks are uniquely identified on the fieldbus network by a character string name, or tag, similar to the device tag. The *block tag* is an attribute of a block that usually describes the purpose and location of the block. You can change the block tag, but block tags must be unique to each block on a fieldbus network.

Linkages

The function blocks configured to control a process are linked, or connected by configuration objects inside the devices. These *linkages* allow you to send data from one block to the other. A linkage is different from a link, in that a link is a physical wire pair that connects devices on a fieldbus network, and a linkage is a logical connection that connects two function blocks.

A block parameter that is written to the bus is referred to as a *published parameter*. A block parameter that is receiving data is referred to as a *subscribed parameter*. Figure 1.4 shows an example of a linkage between blocks. In this example, the output parameter in block A is the published parameter and the input parameter in block B is the subscribed parameter. The blocks can be in the same device or in different devices.

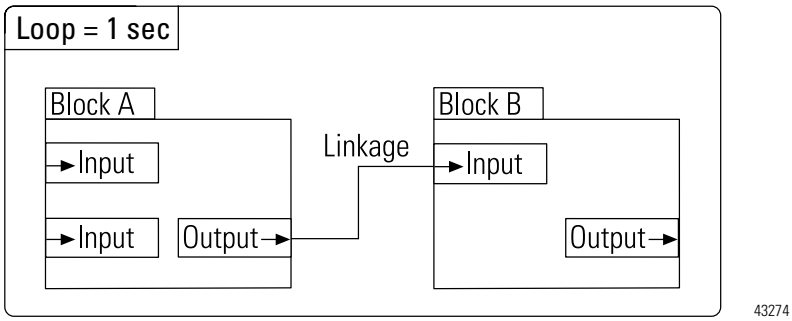
Figure 1.4 Linkage Between Function Blocks



Loops

A *loop* or control loop is a group of function blocks connected by linkages executing at a configured rate. Each block executes at the configured rate and data moves across the linkages between the blocks at the configured rate. Figure 1.5 shows an example of a control loop.

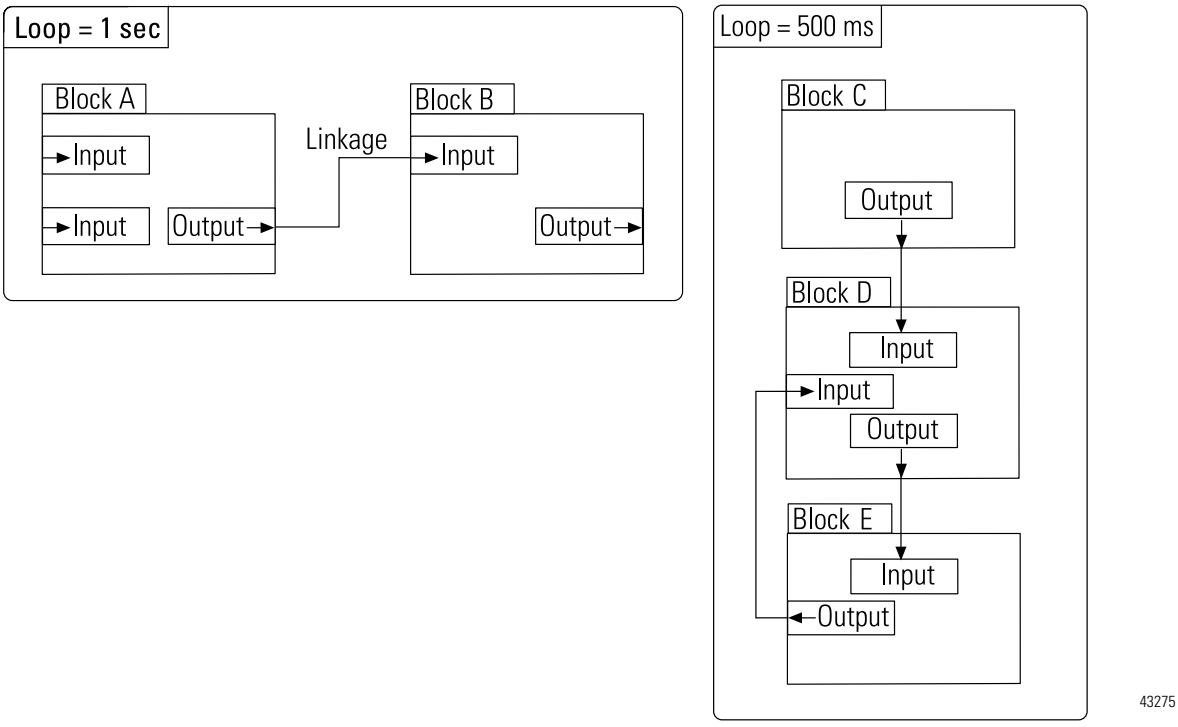
Figure 1.5 Control Loop



Multiple Loops

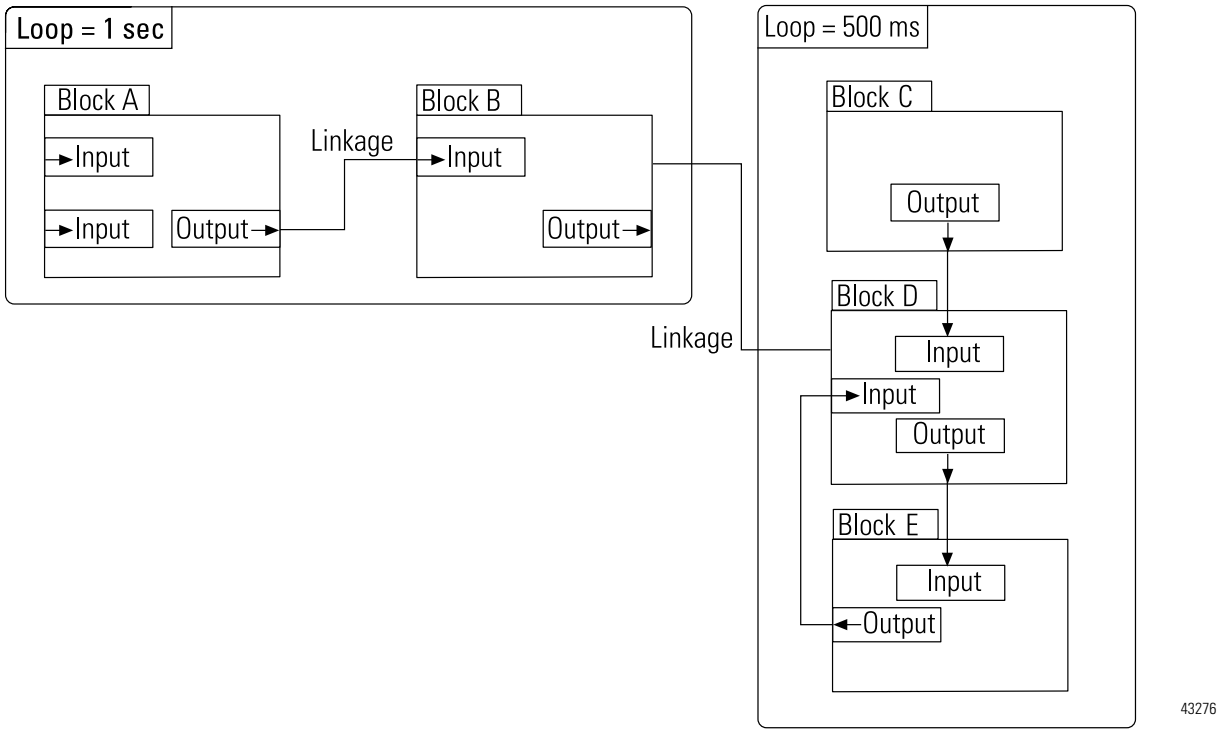
It is possible to have multiple loops running at different rates on a link. Figure 1.6 shows an example of multiple loops.

Figure 1.6 Multiple Loops Running At Different Rates



Even if loops are running at different rates, they can send each other data through linkages. Figure 1.7 shows an example of a linkage between two loops. All loops on a link run within one macrocycle. A *macrocycle* is the least common multiple of all the loop times on a given link. For example, the macrocycle in Figure 1.7 is 1 second.

Figure 1.7 Linkage Between Two Loops



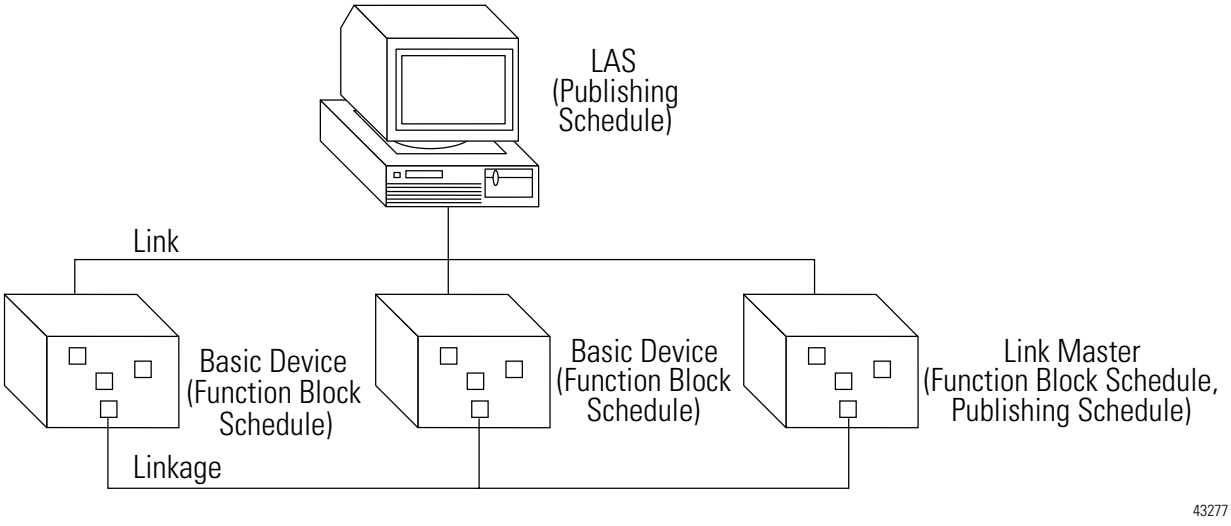
Schedules

A schedule of data traffic allows communication to be *deterministic*, meaning that data is transferred between a given set of devices at the same time during each loop.

The schedule can be divided into two parts: a function block schedule that determines when a block executes, and a publishing schedule that determines when data parameters are published over the fieldbus. The function block schedule is downloaded to the device that contains the function blocks, and the publishing schedule is usually downloaded to a device or devices that have link master capability. The link master running the publishing schedule, and therefore controlling the process, is the LAS.

Downloading the schedule to multiple devices with link master capability ensures that the process is controlled, even if the LAS fails. If the LAS fails, another device with link master capability takes over the bus and runs the schedule. Figure 1.8 shows the relationship of the two schedules to the device, link, link master, and LAS.

Figure 1.8 Publishing and Function Block Schedules Relationships



Configuring a Fieldbus System

This chapter contains brief instructions on how to configure a typical fieldbus system.

Refer to Chapter, Fieldbus Overview, or the *Glossary* for an explanation of fieldbus terms or concepts. Refer to Chapter 3, NI-FBUS Configurator Overview, for information about a specific control or window in the NI-FBUS Configurator.

IMPORTANT Before you use the NI-FBUS Configurator, you must install and configure your software and any fieldbus interfaces, as instructed in your getting started manual.

Configuring a Typical Fieldbus System

The following is an example of a typical fieldbus system configuration, using the NI-FBUS Configurator:

1. Connect the devices in a segment. You can connect devices in one of two ways: online or offline.

   - In the online mode, connect the devices to the fieldbus segment and start the NI-FBUS Configurator.
   - In the offline mode, the devices are not connected to the fieldbus.

   For instructions on how to connect devices, refer to the Configuring Online section on page 4-2.

2. Import the Device Descriptions (DDs) of the connected devices to the computer that runs the NI-FBUS Configurator.

   For instructions on how to import DDs, refer to the Starting the NI-FBUS Configurator section on page 4-1.

3. Set addresses and tags.

   - Each device has a physical device tag and a fieldbus network address. You must assign a unique tag to each device. Each address must be unique within a fieldbus segment.
   - Each device has function blocks that perform control functions, such as AI, AO, DI, DO, PID, and so on. Devices also have transducer blocks that perform I/O with sensors and actuators. You must assign a unique tag to function and transducer blocks.

   For instructions on how to set addresses and tags, refer to the Setting Device or Block Tags and Setting Device Addresses sections on pages 4-5 and 4-6, respectively.

4. Formulate a control strategy.

   - To define your control strategy, identify the function blocks and connect the relevant function blocks. For example, if you are configuring a cascaded PID control, you must identify the primary and secondary PIDs and their inputs and outputs.
   - You must also configure loop times or cycle times. For example, you can configure the primary loop in the cascade to execute at a certain rate, and configure the secondary loop to execute at a different rate.

   For instructions on how to formulate a control strategy, refer to the Formulating a Control Strategy section on page 4-8.

5. Schedule function blocks and communication.

   Fieldbus schedules the execution of function blocks and the communication between the connected function blocks. The two schedules are synchronized to prevent oversampling.

   For instructions on how to edit the schedule, Viewing and Editing a Schedule section on page 4-27.

6. Configure alarms.

Using the NI-FBUS Configurator, you can configure fieldbus devices to generate alarms. Thus, you do not need an HMI to generate alarms. To configure alarms, identify the function blocks that generate alarms and the hosts that receive the alarms. You must also configure the alarm limits and priorities.

For instructions on how to configure alarms, refer to the Configuring Alarms section on page 4-25.

7. Configure trends.

Fieldbus devices collect trend samples (value, status, and time stamps) and broadcast them on the bus periodically. To configure trends, identify the function block (or transducer block) parameters that you want to trend, and configure the sampling rates and types for each of them. You must also identify which host or hosts receive the trend.

For instructions on how to configure trends, refer to the Configuring Trends section on page 4-26.

8. Set static parameters.

For your control strategy to work, you must configure static parameters, such as scaling parameters like XD_SCALE in AI/AO blocks and PV_SCALE in PID blocks. For PID control, you must also configure engineering units, control and I/O options, fault state values for output blocks, and tuning parameters.

For instructions on how to set parameters, refer to the Viewing and Editing Function Block Parameters section on page 4-19.

9. Configure input/output (I/O).

Sensor and actuator I/O is typically modeled as a transducer block. Refer to your sensor or actuator documentation to determine whether you can configure I/O.

For instructions on how to configure I/O, refer to the Viewing and Editing Function Block Parameters section on page 4-19.

10. Set network parameters.

For communication and scheduling to function properly, you must configure the fieldbus communication-specific network parameters. An example of a network parameter is identifying the primary time master and the primary Link Active Scheduler (LAS) devices.

For instructions on how to set network parameters, refer to the Setting Network Parameters section on page 4-30.

11. Download a configuration.

Make sure that all the devices are connected to the bus, and download the configuration.

For instructions on how to download a configuration, refer to the Downloading a Configuration section on page 4-31.

NI-FBUS Configurator Overview

This chapter introduces the NI-FBUS Configurator, lists some of its main features, and describes the main windows of the application.

Introduction to the NI-FBUS Configurator

You can use the NI-FBUS Configurator to configure a fieldbus network and keep track of your configuration changes. The NI-FBUS Configurator is an easy-to-use graphical environment for creating linkages, loops, and a schedule based on the fieldbus concepts described in Chapter, Fieldbus Overview.

Now that you are familiar with the basics of fieldbus communication, you are ready to use the NI-FBUS Configurator. To use the NI-FBUS Configurator immediately, continue to Chapter, Using the NI-FBUS Configurator.

NI-FBUS Configurator Features

You can use the NI-FBUS Configurator to configure a fieldbus network as follows:

- Set block and device tags
- Set device addresses
- Create and edit function block control strategies (function block applications)
- Configure vendor-defined function and transducer blocks
- Create and edit schedules
- Read and write to function block control strategies (function block applications)
- Invoke Device Description (DD) methods
- Display DD menus
- Download a configuration
- Verify a configuration and compare it to a saved configuration
- Monitor a downloaded configuration
- Replace devices
- Log project download changes
- Save and print a configuration

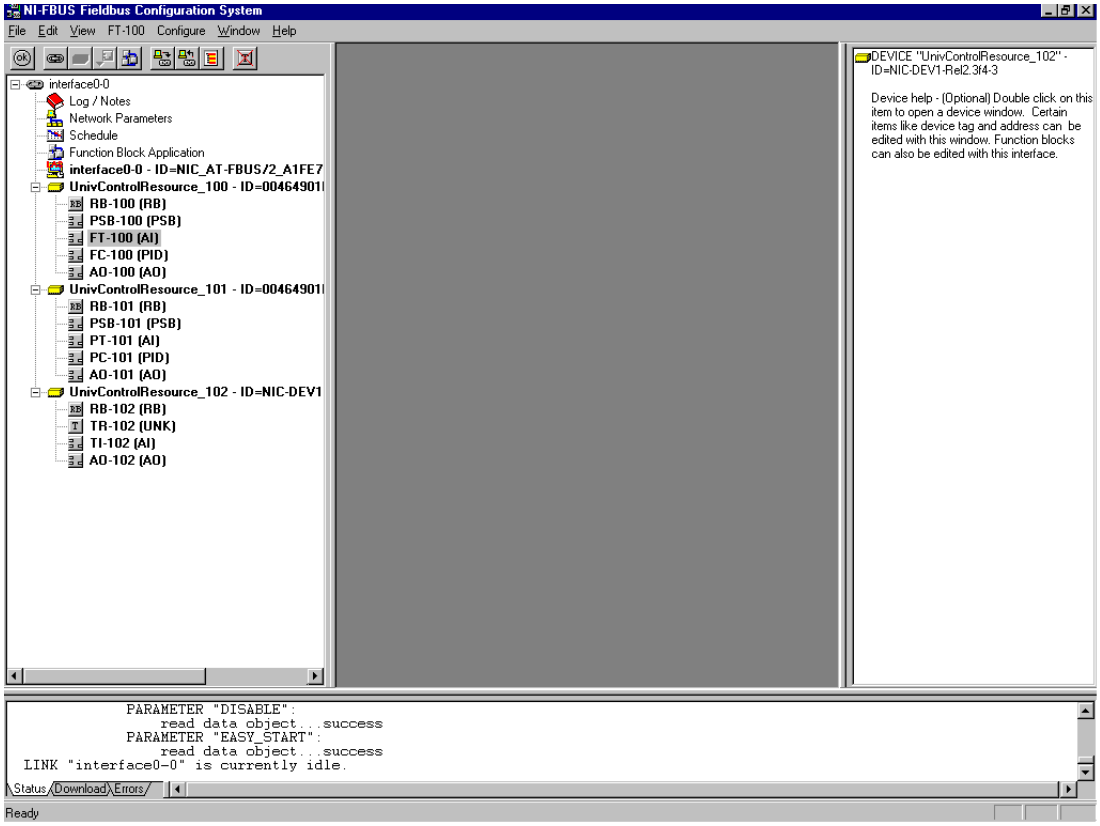
NI-FBUS Configurator Windows

The NI-FBUS Configurator has three moveable, dockable windows within the Configurator Main window: the Project, Help, and Status windows.

Configurator Main Window

The Configurator Main window has menus at the top, and contains the windows described in the following sections. Figure 3.1 shows the Project, Help, and Status windows within the Configurator Main window.

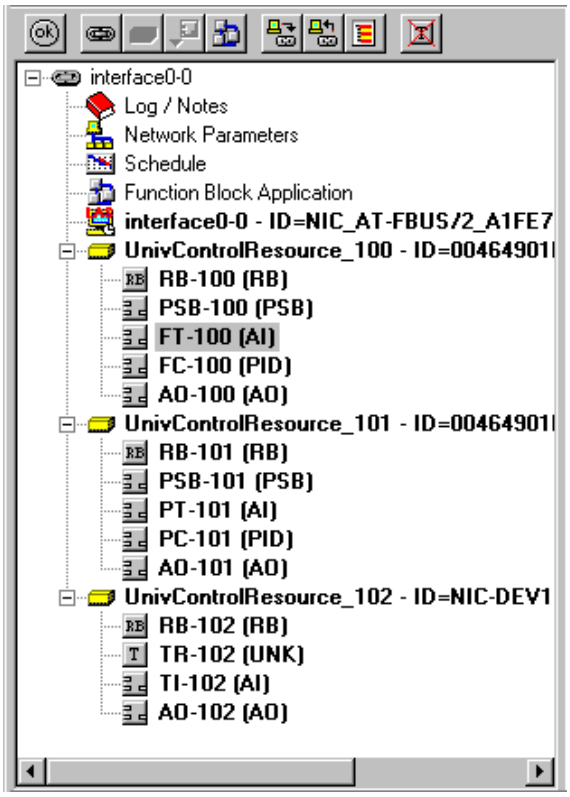
Figure 3.1 Configurator Main Window



Project Window

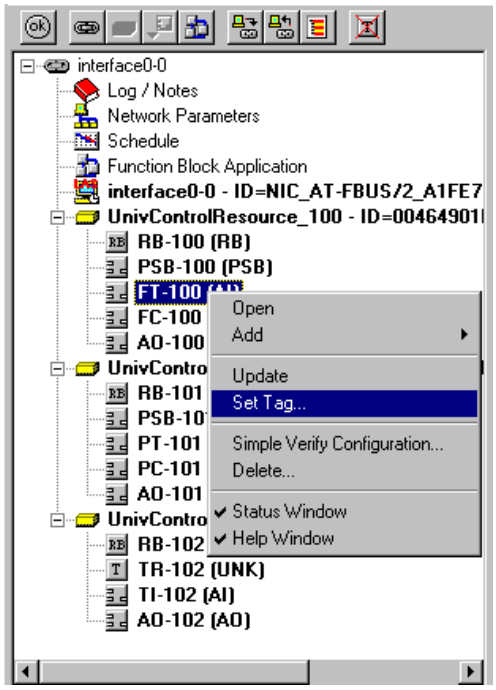
The Project window, which appears to the left of the Configurator Main window by default, displays the configurable objects of the link connected to the NI-FBUS Configurator. To configure each object, double-click these objects in the Project window; doing so opens the correct interface to use to configure the object. Figure 3.2 shows the Project window.

Figure 3.2 Project Window



Each object in the Project window has its own menu that appears on the main taskbar when you select the object. You can also view the menu by right-clicking the object, as shown in Figure 3.3.

Figure 3.3 Project Window Pop-Up Menu



Conventions

The NI-FBUS Configurator uses the following standard user interface conventions:

- Double-click an object to open the configuration interface.
- Right-click an objewct to display a popup menu that lists actions related to that object.
- Single-click an object to select it and display a popup menu in the menu bar at the top of the Main window.
- Single-click an object to select it and hover the cursor over the object to view the help information for that object. The appropriate help information appears in the Help window.
- Drag and drop icons (block or device) from one window and into another.

Icons

Descriptions of the project icons that appear in the Project window follow:

Icon	Name	Description
	Link	This icon represents the fieldbus segment to which your PC is connected. Double-click this icon to open the Network Parameters window.
	Log/Notes	Double-click this icon to see a summary of all the changes you have made to the project link.
	Network Parameters	Double-click this icon to open the Network Parameters window and change the low-level configuration parameters for the link.
	Schedule	Double-click this icon to see the schedule of function block executions and data transmissions for the entire link.
	Function Block Application Editor	Double-click this icon to use the Function Block Application Editor to wire function blocks together into a function block application. You can add multiple function block applications to your project.
	Device	This icon represents a fieldbus device, followed by the device tag and its unique serial identifier. Double-click this icon to open the Device window.
	Host Device	This icon represents the device (PC) that hosts the NI-FBUS Configurator. Double-click this icon to open the Device window.
	Function Block	This icon represents a fieldbus function block, followed by the block tag and its type (in parentheses). Double-click this icon to open the Block window.

State Icons

During the initial scan of the bus, state icons sometimes overlap the project icons. Descriptions of the state icons used in the Project window follow:

Icon	Name	Description
	Updating	This icon appears when the NI-FBUS Configurator is reading or writing to the object.
	Error	This icon appears when the NI-FBUS Configurator detects or encounters an error with the object.
	Invalid	This icon appears when the indicated object is not responding to the NI-FBUS Configurator scan.

Toolbar

The toolbar at the top of the Project window helps you perform basic operations on your project. Figure 3.4 shows the Project window toolbar.

Figure 3.4 Project Toolbar

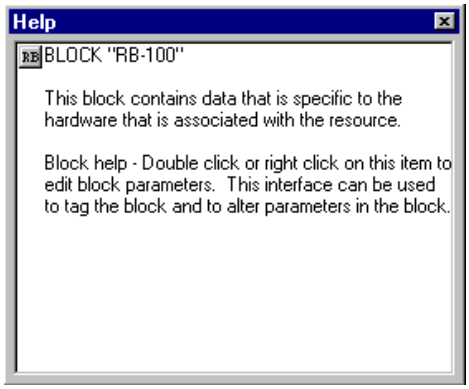
Descriptions of the buttons on the Project toolbar follow:

Button	Name	Description
	Errors	Click this button to validate the project.
	New Link	Click this button to add another link to the project.
	New Device	Click this button to add another device to the project.
	New Block	Click this button to add another block to the project.
	New FBAP	Click this button to add another Function Block Application Editor window to the project.
	Download Project	Click this button to open the Download Configuration dialog box.
	Upload Project	Click this button to reread the configuration.
	Verify and Diff	Click this button to upload your current configuration and compare it to the saved project.
	Show/Hide Transducers	Click this button to hide the transducer blocks from the Project window.

Help Window

The **Help** window, which appears to the right of the Configurator Main window by default, displays help information for the object over which you place your cursor. The text is generated from the NI-FBUS Configurator and Device Description (DD) files. To hide the Help window, select **Window** ⇒ **Help Window**.

Figure 3.5 Help Window


Help
BLOCK "RB-100"
This block contains data that is specific to the hardware that is associated with the resource.
Block help - Double click or right click on this item to edit block parameters. This interface can be used to tag the block and to alter parameters in the block.

Status Window

The **Status** window, which appears at the bottom of the Configurator Main window by default, displays the current status of the NI-FBUS Configurator. When you read, write, scan, or download data to the bus, the Status window shows the steps that the NI-FBUS Configurator takes to accomplish the task on the **Status** tab.

The Status window also contains **Download** and **Error** tabs. The Download tab is updated only when a configuration is downloaded to the bus. The Errors tab shows any errors in the current project. To hide the Help window, select **Window** ⇒ **Status Window**.

Status Tab

The **Status** tab shows live updates of what the NI-FBUS Configurator does on the fieldbus. For example, the Status tab shows when the NI-FBUS Configurator is reading, writing, and configuring. The Status tab automatically appears on top when you start the NI-FBUS Configurator.

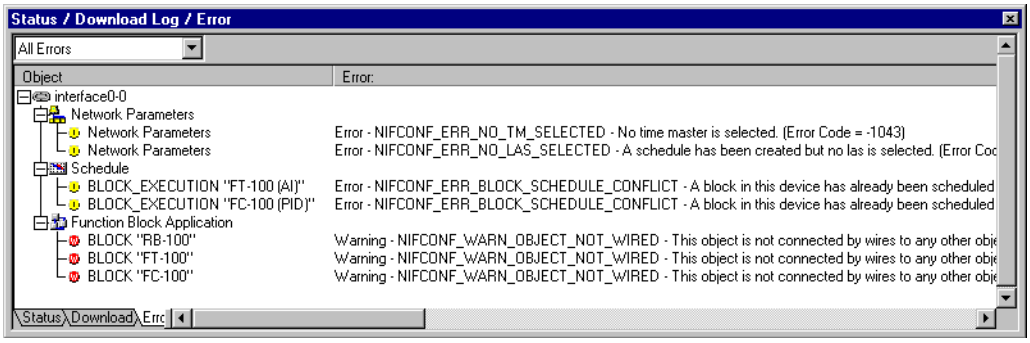
Download Tab

The **Download** tab shows all the status information for the last configuration download of the bus. The NI-FBUS Configurator retains this information until the next download. The Download tab automatically appears on top when you begin to download your configuration. The status information on the Download tab is also in the **Log/Notes** window.

Errors Tab

The **Errors** tab, shown in Figure 3.6, displays all recent I/O errors, project configuration errors, and warnings. To fix an error, double-click the error to open the window containing the error. Some error messages give hints about how to solve the problem. For a list of errors, refer to Appendix, Error Messages and Warnings.

Figure 3.6 Errors Tab


Status / Download Log / Error
All Errors
Object
Error:
interface0-0
Network Parameters
Network Parameters
Error - NIFCONF_ERR_NO_TM_SELECTED - No time master is selected. (Error Code = -1043)
Network Parameters
Error - NIFCONF_ERR_NO_LAS_SELECTED - A schedule has been created but no las is selected. (Error Coc
Schedule
BLOCK_EXECUTION "FT-100 (AI)"
Error - NIFCONF_ERR_BLOCK_SCHEDULE_CONFLICT - A block in this device has already been scheduled
BLOCK_EXECUTION "FC-100 (PID)"
Error - NIFCONF_ERR_BLOCK_SCHEDULE_CONFLICT - A block in this device has already been scheduled
Function Block Application
BLOCK "RB-100"
Warning - NIFCONF_WARN_OBJECT_NOT_WIRED - This object is not connected by wires to any other obje
BLOCK "FT-100"
Warning - NIFCONF_WARN_OBJECT_NOT_WIRED - This object is not connected by wires to any other obje
BLOCK "FC-100"
Warning - NIFCONF_WARN_OBJECT_NOT_WIRED - This object is not connected by wires to any other obje
Status
Download
Erro

The Errors tab has a drop-down list attached to the upper left corner of the window. Use this list to select the errors you want to see. The **All Errors** selection shows all I/O and project errors, and the **Project Errors** selection shows only project errors.

When you download your configuration, the NI-FBUS Configurator checks for errors in your project. If you have a project error, the NI-FBUS Configurator warns you and allows you to cancel the download.

The NI-FBUS Configurator automatically regenerates error information each time you change the project. However, you can force the NI-FBUS Configurator to revalidate the project by clicking the **OK** toolbar button in any window.

Using the NI-FBUS Configurator

The following sections describe how to use the NI-FBUS Configurator to configure your fieldbus system.

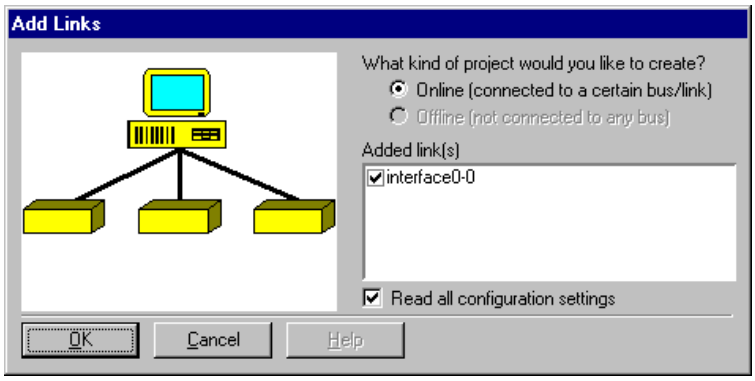
Starting the NI-FBUS Configurator

Before you use the NI-FBUS Configurator, you must install and configure your software and any fieldbus interfaces, as instructed in your getting started manual.

To start the NI-FBUS Configurator, complete the following steps:

1. Select **Start** ⇒ **Programs** ⇒ **NIFBUS** ⇒ **NI-FBUS Configurator**.

   The **Add Links** window opens.



2. To open an existing project, click **Cancel**.

   OR

   To create a new project, select the interface that you want to connect to from the **Added Link(s)** checklist and click **OK**.

Configuring Online

When you start the NI-FBUS Configurator, or when you create a new project, the **Add Links** window opens.

To add new links at any other time, click the **Link** button in the toolbar.

TIP

You can edit saved configuration files without connecting to the fieldbus. To open a saved configuration, click **Cancel** to close the Add Links window that opens. Select **File** ⇒ **Open** and browse to your saved configuration files, which have a .fcp extension.

To connect to a specific fieldbus interface, complete the following steps:

1. In the **Add Links** window that opens, select the interface you want to connect to from the **Added Link(s)** checklist.

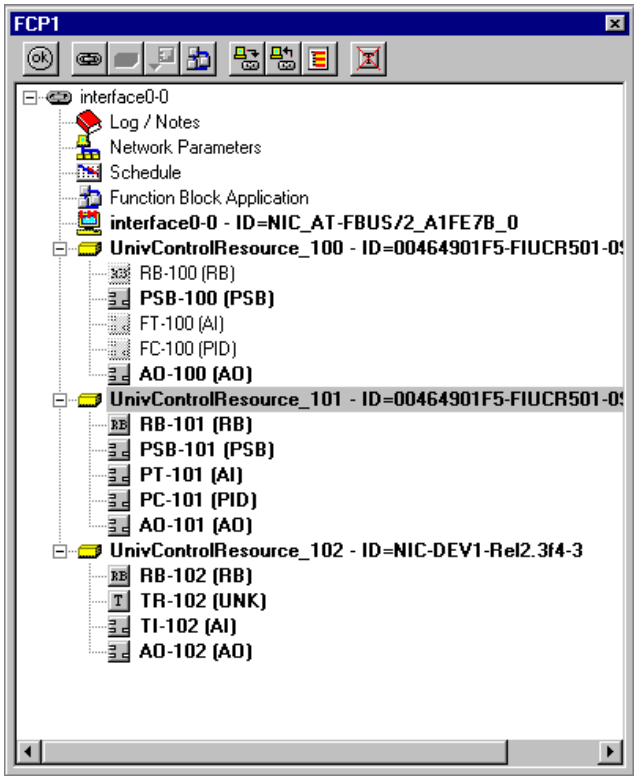
2. Click **OK** to create a new project that is connected to the links you checked.

   The NI-FBUS Configurator scans the fieldbus network and checks addresses and object tags. If a device is missing either an address or a tag, the NI-FBUS Configurator assigns one. If the NI-FBUS Configurator detects duplicate tags, it renames the device or block, appending the original device or block tag with a numeric identifier.

   After you complete the preceding steps, the NI-FBUS Configurator creates a new project so you can develop your configuration. The Project window opens, displaying all the fieldbus objects on the link or links to which your PC is connected.

Figure 4.1 shows the Project window with an example list of fieldbus objects. For more information about the parts of the Project window, refer to the Project Window section on page 3-3.

Figure 4.1 Fieldbus Object List in the Project Window



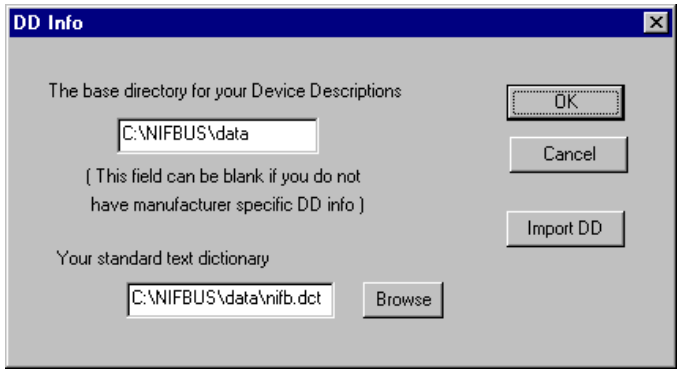
Importing Device Description Files

To use Device Description (DD) files with the NI-FBUS Configurator, you must import the DD files:

1. Select **Start** ⇒ **Programs** ⇒ **NI-FBUS** ⇒ **Interface Config** to run the Interface Configuration utility.

2. Click **DD Info**.

   The **DD Info** window opens.

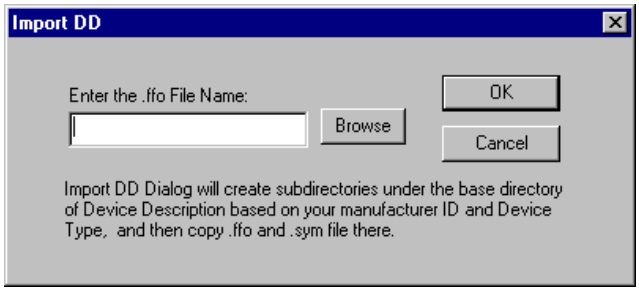


3. Type the base directory for your DD files in the first field.

4. If necessary, click **Browse** to select your standard text dictionary.

5. Click **Import DD**.

   The **Import DD** window opens.


Import DD
Enter the .ffo File Name:
Browse
OK
Cancel
Import DD Dialog will create subdirectories under the base directory
of Device Description based on your manufacturer ID and Device
Type, and then copy .ffo and .sym file there.

6. Click **Browse** and browse to the .ffo DD file path and click **OK**.

For more information about DD files, refer to the Device Description Files section on page 1-5.

Setting Device or Block Tags

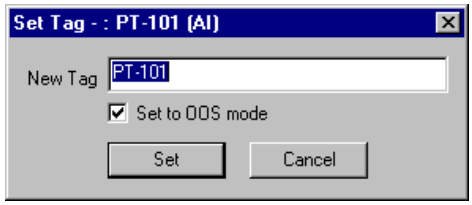
Setting a device or block tag may affect how other host machines on an (online) operating network access the device.

IMPORTANT The operating control system must not be using the device or function block when you set tags. When you set the device tag, the device loses all linkage and communication configuration information and loses control of the process.

To set a tag, complete the following steps:

1. In the Project window, select the device or block whose tag you want to change.
2. Right-click the device or block, or select **Object Name** from the main menu bar.
3. Select **Set Tag** from the pop-up menu that opens.

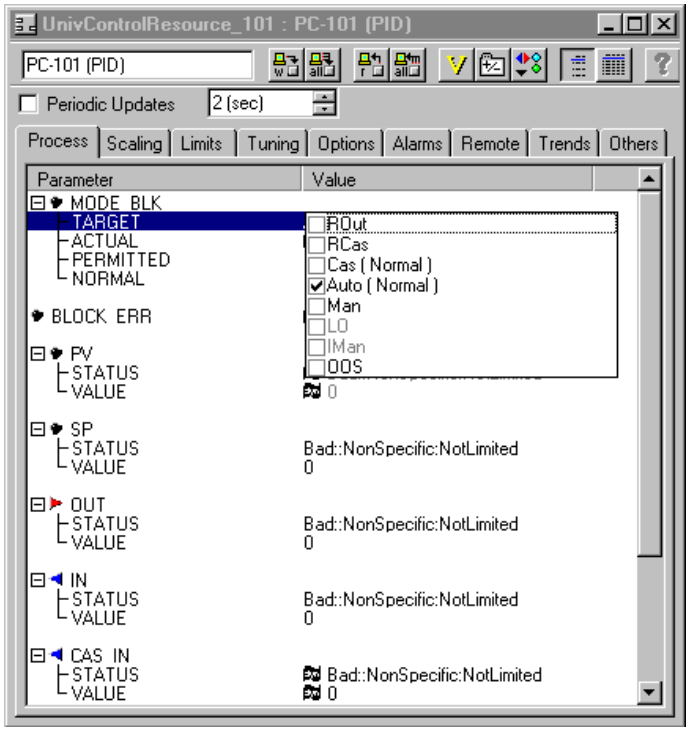
   The Set Tag window opens.



4. In the **New Tag** field, type the tag you want to assign to the object.
5. Select the **Set to OOS Mode** checkbox. Doing so sets the block to OOS mode, which prevents the device from operating in its current control system.
6. Click **Set**.

   The NI-FBUS Configurator sets the block or device to OOS mode before setting the new tag. If the device or block does not go to OOS mode, the NI-FBUS Configurator notifies you and you must determine whether to continue setting the tag.

7. After you successfully set the tag, use the Block window to change the block from OOS mode to a desired mode.



Setting Device Addresses

IMPORTANT The operating control system must not be using the device when you set the address. When you set the address, the device deletes all communication information.

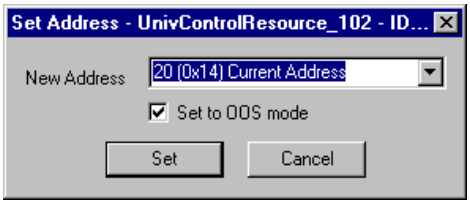
Complete the following steps to set the device address:

1. In the Project window, select the desired device.

2. Right-click the device or select **Devices** from the main menu bar.

3. Select **Set Address** from the pop-up menu that opens.

   The **Set Address** window opens.



4. In the **New Address** field, select the desired address from the drop-down list.

5. Select the **Set to OOS Mode** checkbox. Doing so sets the block to OOS mode, which prevents the device from operating in its current control system.

6. Click **Set**.

   The NI-FBUS Configurator sets the device resource block to out of service (OOS) mode before setting the new address. If the device does not go to OOS mode, the NI-FBUS Configurator notifies you and you must determine whether to continue setting the address.

7. After you successfully set the address, you can set the resource block to the desired mode (typically NORMAL_MODE).

Resetting a Device to Factory Defaults

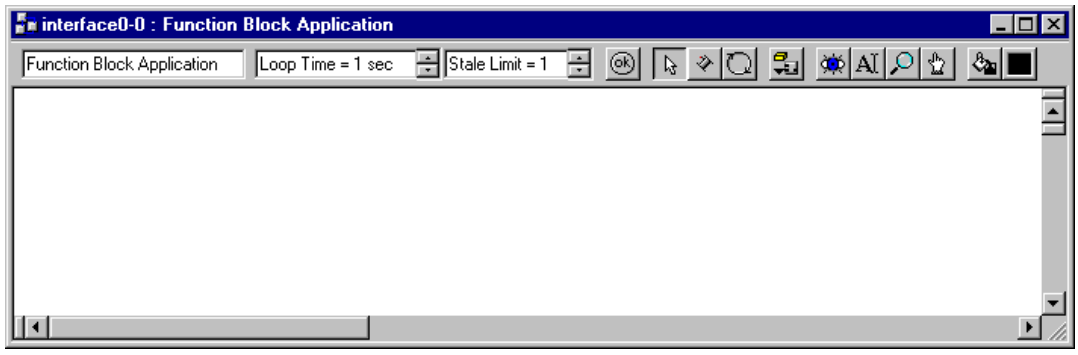
You can clear a device so that it is reset to a state appropriate for shipping. To do so, right-click on the device name in the Project window and select **Set to Factory Defaults** from the popup menu that opens.

The NI-FBUS Configurator clears the device and function block tags, along with the device address. In addition, it clears all communication information in the device.

Formulating a Control Strategy

The Function Block Application Editor, shown in Figure 4.2, is the graphical interface you use to create your fieldbus control strategy in the NI-FBUS Configurator.

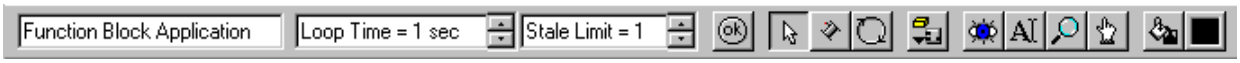
Figure 4.2 Function Block Application Editor



You can open the Function Block Application Editor by double-clicking on its icon in the Project window.

The toolbar at the top of the Function Block Application Editor, shown in Figure 4.3, displays the various tools used for function blocks.

Figure 4.3 Function Block Application Editor Toolbar



Descriptions of the items on this toolbar follow:

Table 4.1 Function Block Application Toolbar Descriptions

Toolbar Item	Name	Description
Function Block Application	FBAP Name	This field shows the name of the function block application.
Loop Time = 1 sec	Loop Execution Time	This field shows the default execution rate of the process loop.
Stale Limit = 1	Stale Limit	This field shows the number of consecutive duplicate values that a function block accepts before it labels the input data as stale (old data).
	Errors	Click this button to perform error checking, regenerate the schedule of the application, and remove bad wires.
	Pointer	Click this button to drag and highlight objects on the screen.
	Wiring	Click this button to make connections between valid inputs and outputs. When you try to make a connection, the NI-FBUS Configurator checks the data type of the input and output you are trying to connect, and highlights the connection if it is valid.
	Loop	Click this button to isolate certain function blocks from the default execution time. The default execution time on the toolbar is the execution rate for all blocks on the Function Block Application Editor. However, you can define multiple loops that run at rates other than the default execution time. The Loop tool helps you to assign a special execution rate to a group of function blocks. For more information about running loops at different rates, refer to the Defining Multiple Loops section of this chapter.
	Block	Click this button to show the block menu.
	Monitor FBAP	Click this button to enable graphical monitoring of the process.
	Text	Click this button to type additional information about the application to the screen and change text in fields.
	Zoom	Click this button to zoom in and out. To zoom in, drag a rectangle around the area you want to enlarge. To zoom out, right-click on the background of the Function Block Application Editor window.
	Execution Order	Click this button to choose the order of execution for blocks. The NI-FBUS Configurator automatically decides the order of the blocks, but you can change the default order by using the Execution Order tool to click on the blocks in the order you want them to execute.
	Fill	Click this button to fill objects on the screen with a color.
	Fill Color	Click this button to select a color to be used with the Fill tool.

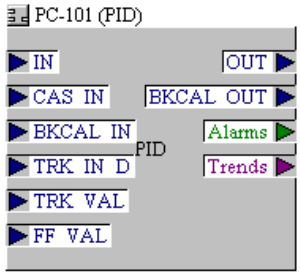
TIP

To switch between the major tools you are using, press <Tab>. To switch between the pointer and the wiring tool, press the spacebar.

Function Blocks

As stated in the Blocks and Parameters section of Chapter 1, function blocks contain an algorithm and several parameters to control a process. The input and output parameters of this function block are displayed on the block, as in Figure 4.4.

Figure 4.4 Input and Output Parameters on a Function Block



The pointers on the outside of the parameters show the direction of the data flow. By default, the block tag is at the top, the inputs are on the left, and the outputs are on the right.

You can resize the block and move the tags relative to the block.

To change the tag, double-click the block tag to open the edit box, or right-click and select **Set Tag** from the drop-down list.

Adding Function Blocks

To add function blocks, complete the following steps:

1. To open the Function Block Application Editor, double-click the Function Block Application Editor icon in the Project window.

2. Drag blocks from the Project window to the Function Block Application Editor until all the blocks you want to use are in the Function Block Application Editor. A block looks like the following while you drag it from the Project window:

3. If you want to change the names of the blocks, double-click a tag or use the **Text** tool on the Function Block Application Editor toolbar.

You can also add function blocks as follows:

1. Right-click on the background of the Function Block Application Editor or click the **Block** button.

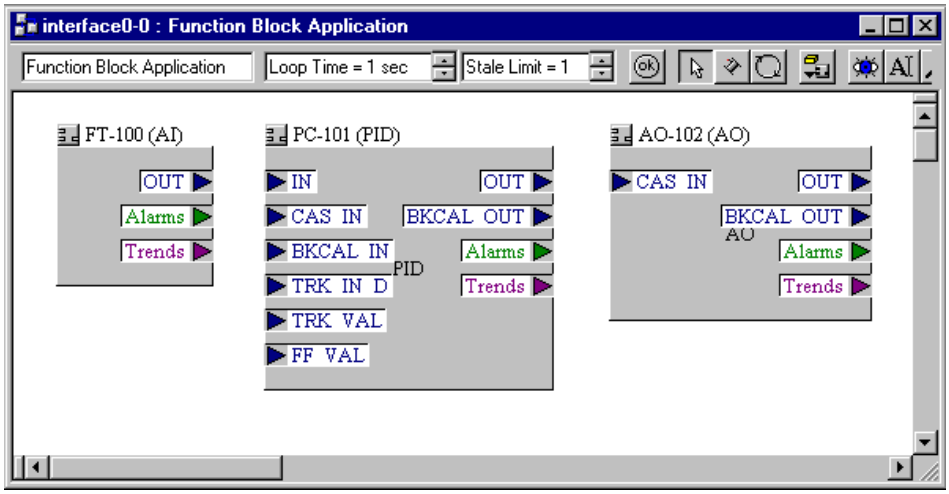
2. Select the device from the menu that opens, then select the block you want to place on the screen from the menu of function blocks.

TIP

You can use a function block on a fieldbus network only once. After you use a function block in a Function Block Application Editor window, the function block is grayed out on the menu and in the Project window.

Figure 4.5 shows how the Function Block Application Editor looks with function blocks dragged onto it.

Figure 4.5 Added Function Blocks



Connecting Blocks

To send data from one block to another, you must connect the blocks through wiring. You can wire blocks manually or use a template.

Wiring Blocks Manually

To wire blocks manually, complete the following steps:

1. Click the **Wiring** tool on the Function Block Application Editor toolbar.
2. Click the input or output you want to connect.
3. Click on the background of the Function Block Application Editor window to guide the connection to the input or output to which you want to attach the wiring.

TIP

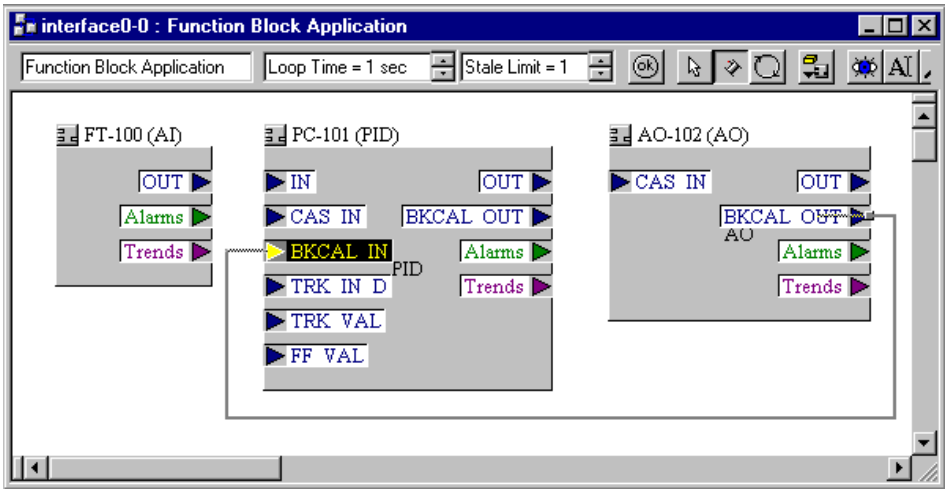
To toggle the direction of the connection you are dragging, press the spacebar while wiring.

4. Click the input or output to which you want to wire.

When you click the Wiring tool, the NI-FBUS Configurator performs type checking and highlights valid inputs and outputs when you move the cursor over them.

Figure 4.6 shows the BKCAL IN of the PID block being wired to the BKCAL OUT of the AO block.

Figure 4.6 Wiring to a Block Input



You can also drag devices from the Project window into the Function Block Application Editor to configure alarms and trends, as described in the Configuring Alarms and Configuring Trends sections on pages 4-25 and 4-26, respectively.

Using Pre-Wired Templates

Templates are predefined, pre-wired control loops that you can drag into the Function Block Application Editor to use as a model for your function block application. The NI-FBUS Configurator includes several types of templates.

You can also save your own template as a file by selecting **File** ⇒ **Save Template**. The NI-FBUS Configurator saves all templates in the c:\Nifb\fcs\templates directory. If a template is in that directory, it automatically opens in the template menu.

To access templates, do one of the following:

- Right-click on the background of the Function Block Application Editor and select **FBAP Templates**.

  or

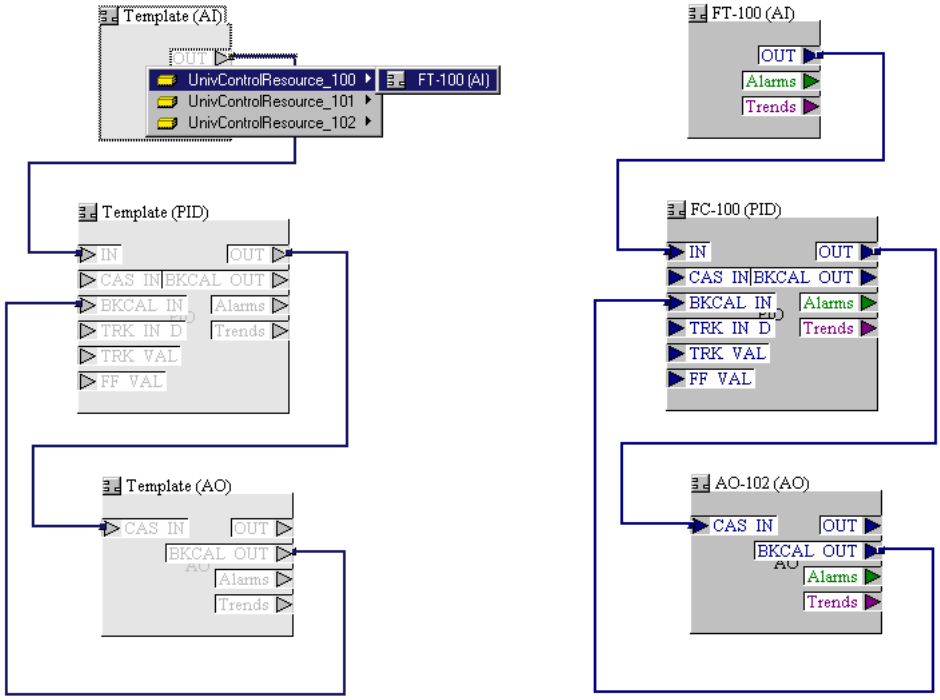
- Select **File** ⇒ **Open Template**.

The NI-FBUS Configurator includes the following templates:

- PID Feedback Control
- Manual Control with PV Indication
- PD Feedback Control
- Track Feedforward Control
- Cascade Control
- Ratio Control
- Override Control

Figure 4.7 shows an example of a template.

Figure 4.7 Example Template



If template blocks are grayed out, as shown on the left in Figure 4.7, you have not assigned a function block to the template block. To assign a function block to the template block, complete the following steps:

1. Double-click the template block to view all the blocks that match this block type in your project. You can also right-click the block and select **Replace** from the popup menu that opens.

2. Select the desired block from the list that opens.

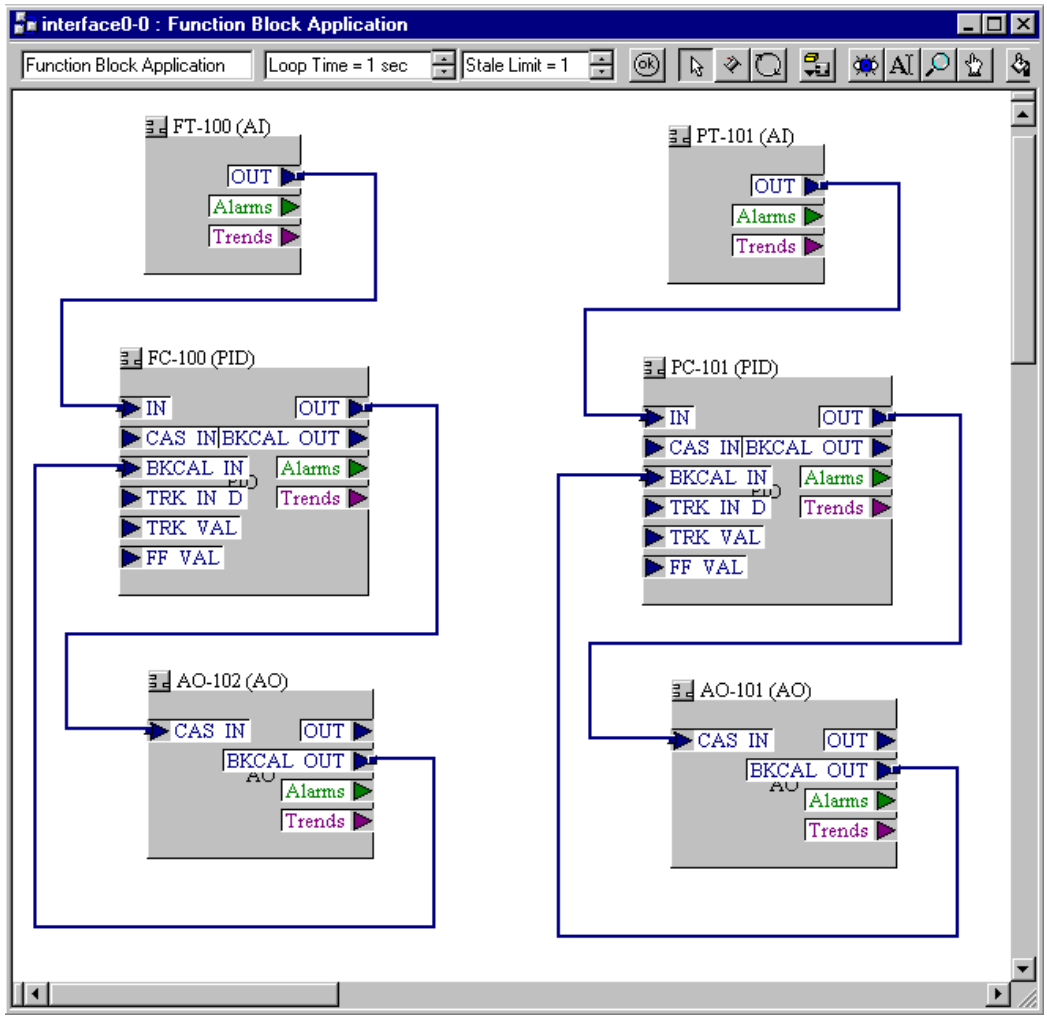
Your application is not complete until you replace all the template blocks with function blocks from your project, as shown on the Right in Figure 4.7.

Defining Multiple Loops

A *loop* is a group of connected function blocks that execute at a specified rate. You can define many loops in one Function Block Application Editor window.

Figure 4.8 shows an example of two separate loops running at the same rate.

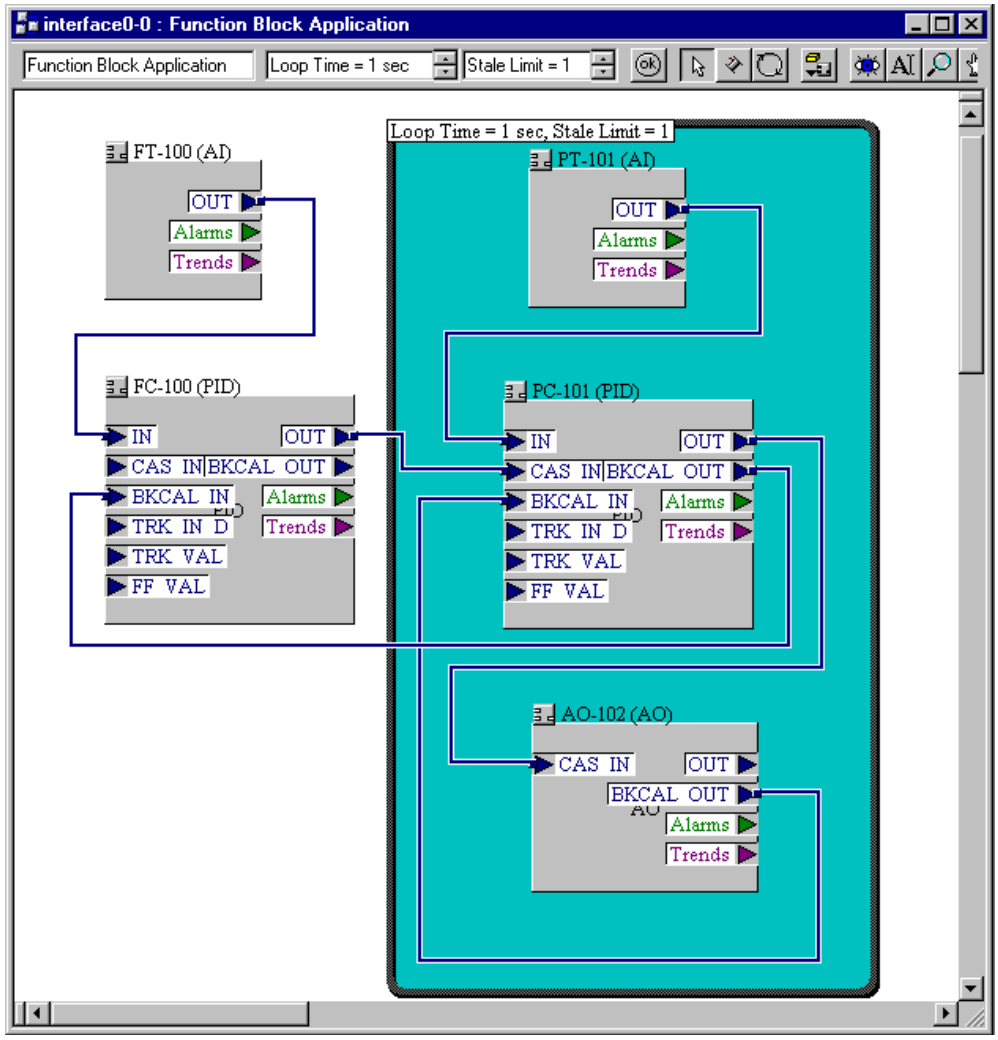
Figure 4.8 Multiple Loops



Defining Multiple Loops Running at Different Rates

The loop execution time shown on the Function Block Application Editor toolbar is the default execution time for all function blocks on the window *not* isolated in a loop structure. For example, the AI and PID blocks in Figure 4.9 execute at a rate of once every second, but the AI-PID-AO loop can be set to execute at another time by modifying the time at the top of the shaded area.

Figure 4.9 Two Loops Running at Different Rates



You can use the loop structure shown in Figure 4.10 to isolate a group of function blocks to run at a different execution rate than the rate on the Function Block Application Editor toolbar.

Figure 4.10 Loop Structure

To create a loop structure, complete the following steps:

1. Click the **Loop** tool on the Function Block Application Editor toolbar.

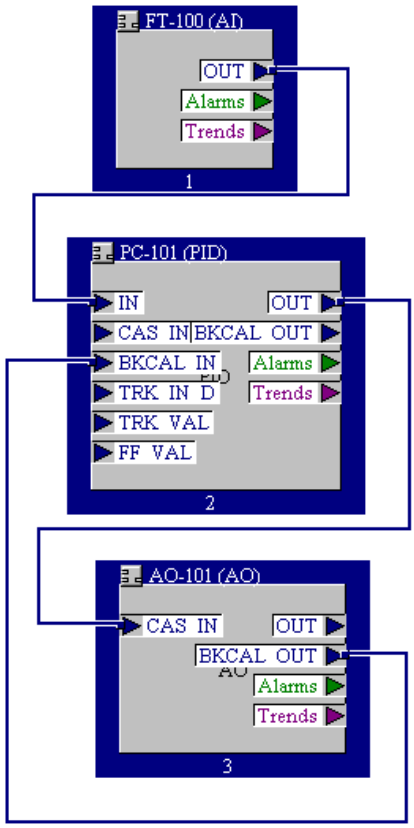
2. On the background of the Function Block Application Editor, click and drag a loop around the blocks you want to put in the loop.

3. To change the loop execution time, type the new time in the box at the upper left of the loop.

Changing the Block Execution Order

To change the execution order of the blocks, complete the following steps:

1. In the Function Block Application Editor, click the **Change Execution Order** button. Numbers appear on the blocks, indicating their current order.



2. Click on the blocks in the order that you want them to execute.

3. When you are done, click on the background of the Function Block Application Editor window or select another tool.

Viewing and Editing Function Block Parameters

Each function block in your application has a Block window that you can use to change block parameters and other settings. When you read or write data on a block, the Status window shows the status of the transactions.

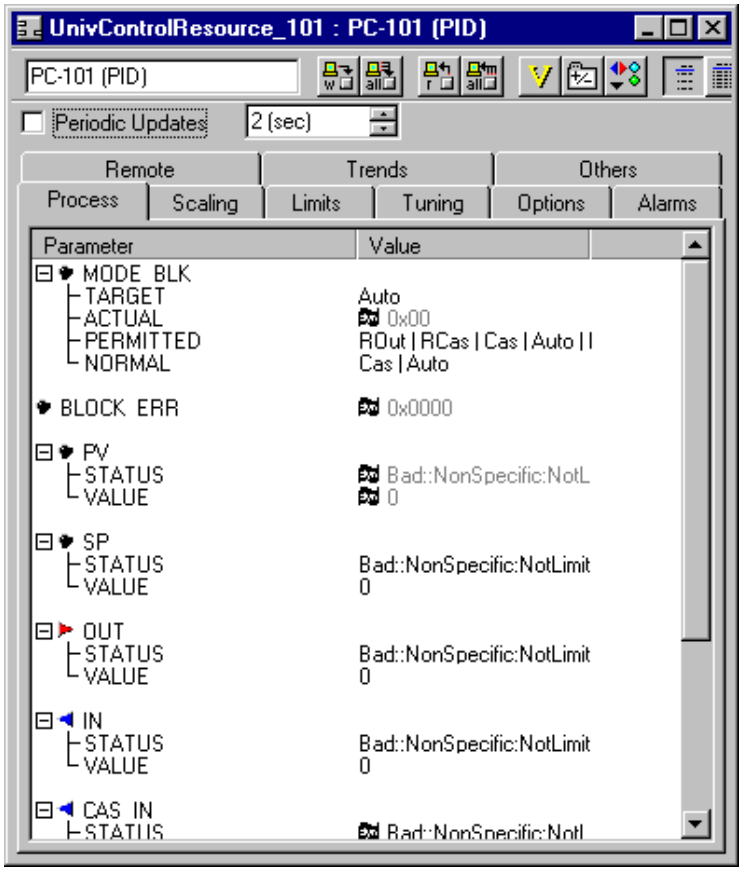
To open the Block window for a block, do one of the following:

- Double-click on the name of the function block in the Project window.

  OR

- Double-click on a function block in the Function Block Application Editor.

Figure 4.11 Block Window



Block Window Icons

As shown in Figure 4.11, an icon to the left of each parameter name color-codes and symbolically represents the class of the parameter. Table 4.2 describes the classes of the parameter.

Table 4.2 Block Window Icons

Shape	Color	Description
Circle	Alarms—Green	Represents contained parameters. Contained parameters cannot be linked to other parameters; they are contained in the block.
	Tuning—Light blue	
	Others—Black	
Right arrow	Red	Represents output
Left arrow	Blue	Represents input

Block Window Toolbar

The toolbar at the top of the Block window provides an interface for reading and writing parameters. Figure 4.12 shows this toolbar.

Figure 4.12 Block Window Toolbar

Descriptions of the icons on this toolbar follow:

Toolbar Item	Name	Description
PC-101 (PID)	Device Tag	This field shows the function block tag. To change the block tag, click the field.
	Write Changes	Click this button to write only changed parameters to the block on the device, including changed block tags.
	Write All	Click this button to write all parameters, including changed block tags, to the block on the device.
	Read Selected	Click this button to read a selected parameter.
	Read All	Click this button to read all parameters.
	Refresh	Click this button to update the screen.
	Customize	Click this button to add, delete, or rename tabs for this type of block.
	Spaced View	Click this button to add space between parameter listings.
	Simple View	Click this button to display only the **Parameter** and **Value** columns.
	Detailed View	Click this button to display the **Parameter**, **Value**, **Type & Range**, and **Help** columns.

Tabs of the Block Window

The Block window groups the parameters by functional category. For example, parameters related to alarms appear on the **Alarms** tab, and parameters related to tuning appear on the **Tuning** tab. Uncategorized parameters appear on the **Others** tab.

You can also customize the tabs of the Block window. You can add or delete tabs, change the order in which they appear in the window, and add or remove any block parameters.

TIP

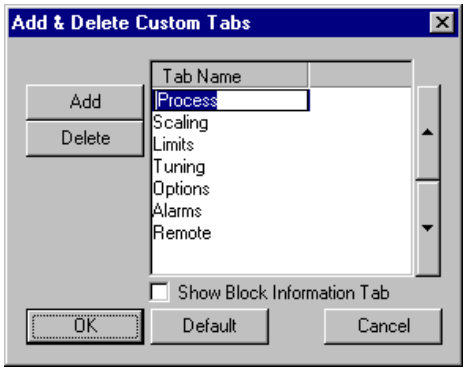
When you customize a tab of the Block window, that customization applies to all blocks of the same type. In other projects, blocks of the same type will have the same tab configuration.

Adding Tabs

To add a tab to the Block window, complete the following steps:

1. Click the **Add or Delete Custom Tab** button in the Block window toolbar.

   The Add & Delete Custom Tabs window opens.



2. Click the section where you want to add the tab.

3. Click **Add** and type the name of the new tab in the edit control that opens.

4. Click **OK** to generate the new tab.

Removing Tabs

To remove a tab from the Block window, complete the following steps:

1. Click the **Add or Delete Custom Tab** button in the Block window toolbar.

   The **Add & Delete Custom Tabs** window opens.

2. Select the name of the tab that you want to remove.

3. Click **Delete**.

Customizing Parameters

To customize the parameters on a Block window tab, right-click on the tab in the Block window to display the popup menu and select **Customize Parameters**.

Editing Block Parameters

The Block window displays the parameters in the order that they appear in the block. Parameters with a plus sign beside them are records or arrays (structures) that contain more than one entry. To expand the record or array, click the plus sign, or to collapse the structure, click the minus sign.

To edit a block parameter value, complete the following steps:

1. In the Function Block Application Editor, double-click a function block to open the Block window.

2. To see the values of the record or array parameters in the Block window, click the plus signs.

3. To change a paramter value, select the value and type in the new value. If a parameter value is grayed out, it is read-only and you cannot change it. After you change a parameter value, an asterisk (*) appears by the parameter name.

4. To make your changes effective immediately, click the **Write changes** button on the Block window toolbar. If you do not click the Write changes button, your changes will not take effect until you download the configuration.

Updating Block Parameter Values

You can update block parameter values manually or automatically, as described below:

Manually

To update each block parameter value manually, select the parameter and click the **Read Selected** button on the Block window toolbar.

To update all of the block parameter values, click the **Read All** button.

Automatically

To update the block parameter values automatically, complete these steps:

1. At the top of the Block window, select the **Periodic Updates** checkbox.

2. Select the poll rate from the drop-down list to the right of the Periodic Updates checkbox.

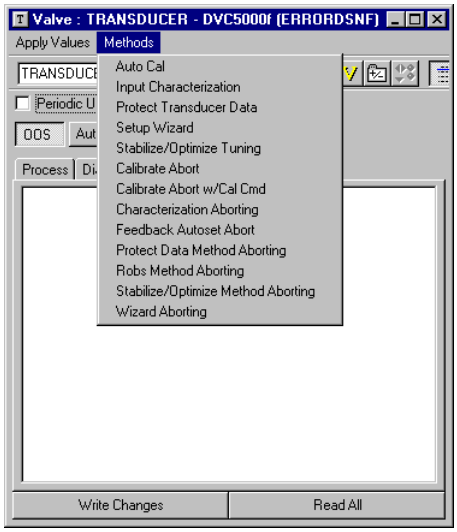
The NI-FBUS Configurator updates the block parameter values periodically, based on the poll rate you choose.

Using Menus and Methods

If you double-click a function block in the Project window and the block has menus and methods associated with it, a menu bar opens above the Block window toolbar and the **Methods** tab opens in the Block window.

To invoke a method, select it from the menu bar.

Figure 4.13 Methods pull-down menu

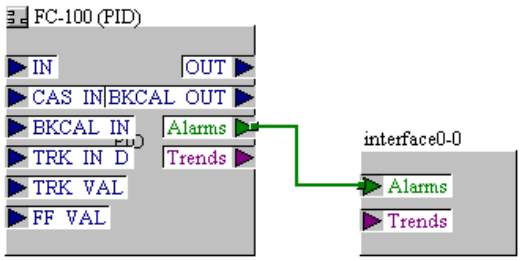


Configuring Alarms

To configure a device, such as a PC, to receive alarms generated by function blocks complete the following steps:

1. Locate the Project window icon for the device or interface to which you want to send the alarm. Drag this icon from the Project window to the Function Block Application Editor.

2. Wire the **Alarms** output of the block that you want to generate the alarm to the device you want to receive the alarm. The following an example of a configured alarm.



3. Double-click the function block that you want to generate the alarm.

   The Block window opens.

4. Select the **Alarms** tab to view or change alarm information, such as the high and low limits of an alarm condition, alarm priorities, and so on.

Configuring Trends

You can configure a device, such as a PC, to receive trends from fieldbus devices. To configure trends, complete the following steps:

1. Find the Project window icon for the device or interface to which you want to send the trend. Drag this icon from the Project window to the Function Block Application Editor.

2. Double-click the function block from which you want to send a trend.

   The Block window opens.

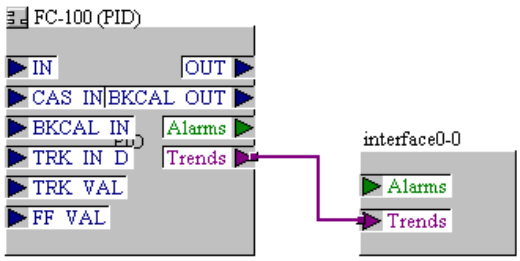
3. Select the **Trends** tab.

4. Select the checkbox in the **Trend** column next to the parameter you want to trend.

5. Set the sample **Interval** of the trend in loops/sample.

6. Set the **Sample Type**. To do so, select **Instant** or **Average** from the Sample Type drop-down list. Instant trends the actual value. Average trends all samples.

7. Wire the **Trends** output of the block to the device you want to receive the trend. The following is an example of a configured trend.

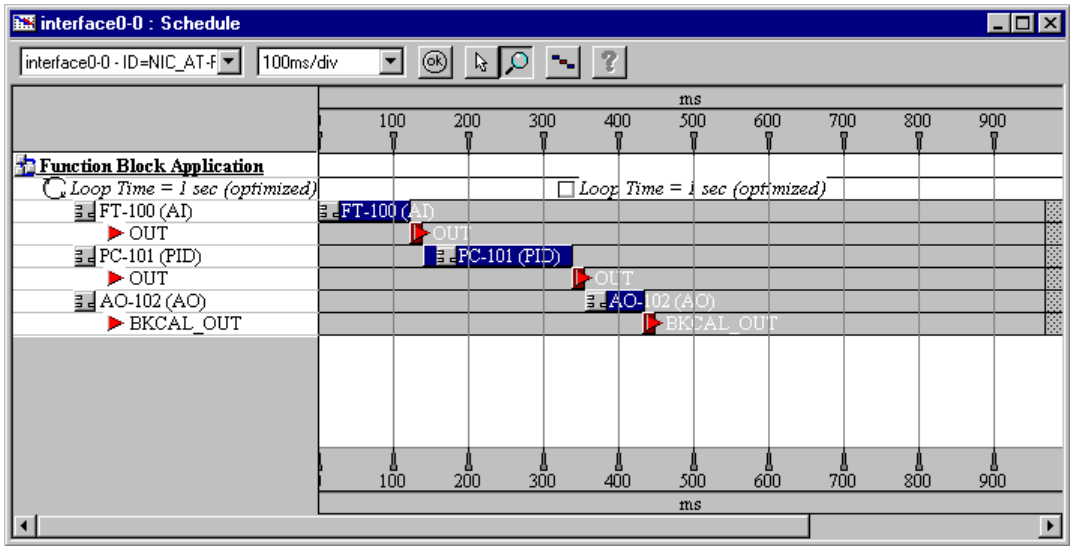


Viewing and Editing a Schedule

The NI-FBUS Configurator automatically determines the execution order and timing of the schedule based on your control strategy, network and device factors, and on the loop execution rate you choose. The NI-FBUS Configurator also automatically optimizes the schedule. Double-click the **Schedule** icon in the Project window to view or edit the link active schedule.

The NI-FBUS Configurator combines the link active schedule and function block schedules into one diagram, as shown in Figure 4.14.

Figure 4.14 Schedule Window



In the Schedule window, a key of the scheduled objects appears on the left. The timing diagram on the right displays the execution times of the function blocks, and when data is transmitted on the bus.

The blue bars on the screen correspond to the function block execution times and the red bars correspond to the data transmission times, which consist of LAS notification time and transmission time.

TIP

An optimized schedule can show that the transmission time overlaps the end time for the function block because the transmission time includes the time that the LAS uses to tell the device to send the data.

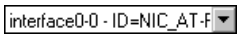
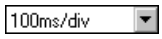
To change the execution time for a loop, click the **Loop Time** next to the loop icon and type in the new time.

Schedule Window Toolbar

Figure 4.15 shows the toolbar for the Schedule window.

Figure 4.15 Schedule Toolbar

Descriptions of the icons on the Schedule window toolbar follow:

Toolbar Item	Name	Description
	Primary LAS	This field displays the name of the device that is the primary LAS for the system.
	Scale	This field displays the time and divisions on the timing diagram.
	Errors	Click this button to validate the schedule.
	Pointer	Use this tool to drag the time bars around on the timing diagram.
	Zoom	Click this button to zoom in and out on the view.
	Optimize Schedule	Click this button to rerun the optimization routine.

Changing the Link Active Schedule

You do not need to alter the schedule if the function block execution times in the device are correct. If the times in the device are incorrect, you might have to tune the execution times by dragging the execution time bars on the screen. Automatic optimization is shut off when you drag the bars to tune. If you want to reoptimize, click the **Optimize Schedule** button.

If the function block execution times in a device are incorrect, or if your control application needs a different schedule, you might want to change the schedule by completing the following steps:

1. Double-click the **Schedule** icon in the Project window.

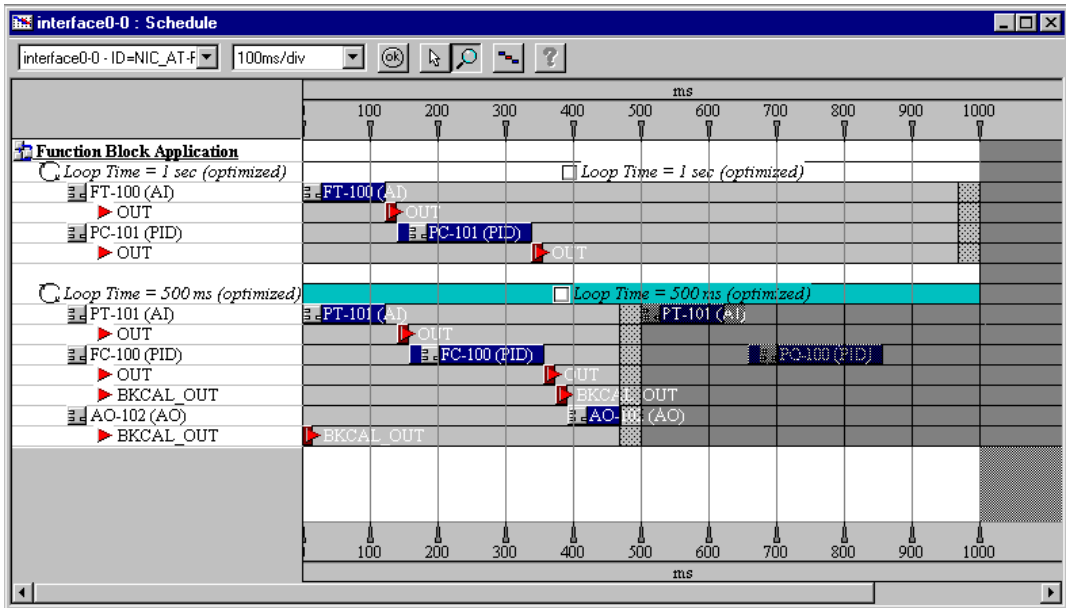
   The Schedule window opens.

2. Use the cursor to move the function blocks in the schedule as needed.

Multiple Loop Representation

Figure 4.16 shows how the NI-FBUS Configurator displays multiple loops in the Schedule window.

Figure 4.16 Multiple Loops in a Schedule

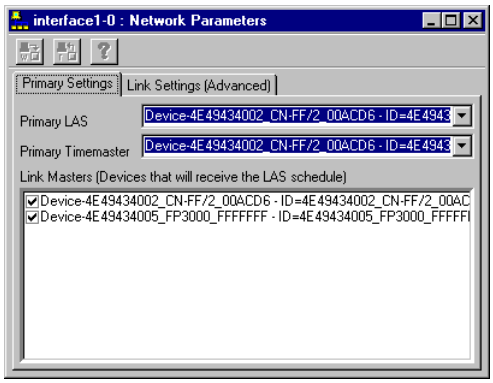


The loops are separated by white dividers. Select the checkbox by the loop time shown above the colored bars to lock the loop and prevent you and the NI-FBUS Configurator from changing the schedule until you uncheck the box.

Setting Network Parameters

To change network parameters such as the Link Active Scheduler (LAS) and primary time master, double-click the **Network Parameters** icon in the Project window, or click the **Link Masters** button in the **Download Configuration** window.

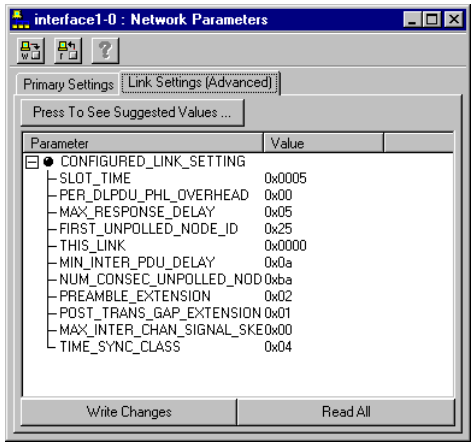
The **Network Parameters** window opens.



This window lists all devices capable of being link master. Every device you select in this window receives the Link Active Schedule when you download your configuration. Thus, if the primary LAS is unavailable, one of these devices will execute the fieldbus schedule.

To review or modify the details of the link settings, select a device and then select the **Link Settings (Advanced)** tab.

The specific parameters are displayed.



These paramters can be modified as required. Suggested values can be viewed by clicking on the box above the parameters.

Downloading a Configuration

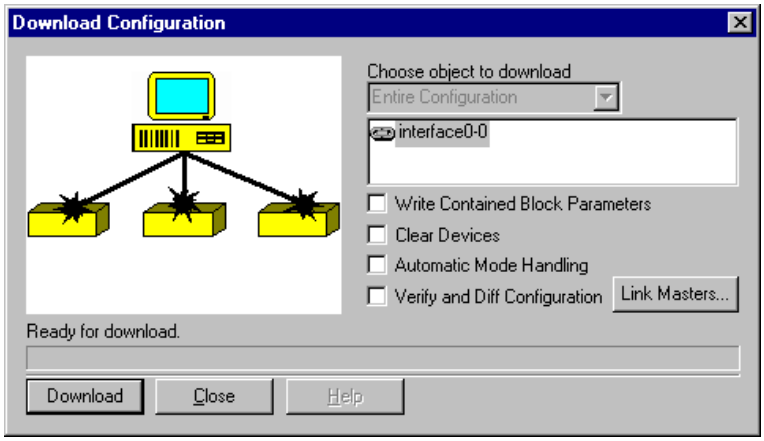
When you download a configuration, the NI-FBUS Configurator configures the following items:

- Function block linkages between devices
- Function block schedule
- Alarms configuration
- Trends configuration
- Static parameters
- Communication schedule for the LAS

To download your configuration, complete the following steps:

1. Click the **Download** button in the Project window toolbar or select **Configure** ⇒ **Download Configuration**.

   The **Download Configuration** window opens.



2. Select the configuration object to download.

3. Click **Link Masters...** to set link masters to receive the LAS, the primary LAS, and the primary time master of the link.

   The **Network Parameters** window opens.

4. (Optional) To write all of the contained parameters of function blocks in the project, select the **Write Contained Block Parameters** checkbox.

5. (Optional) If you want to make sure that the device does not have any communication configuration information that connects to devices outside the configuration you are downloading, you can reset or clear all of the communication connections from the devices on the bus. To do so, select the **Clear Devices** checkbox.

6. (Optional) If you want the NI-FBUS Configurator to switch function blocks in the configuration to OOS mode and back to the desired mode automatically, select the **Automatic Mode Handling** checkbox.

   If you do not select this checkbox, you are responsible for changing the modes during the download process.

7. To download your fieldbus configuration changes to the network, click **Download**.

   The **Download Status** progress bar shows what percentage of the configuration is complete.

   While downloading, the NI-FBUS Configurator displays and updates the **Download** tab in the status window. It shows what devices are configured, their settings, and whether it was successfully configured.

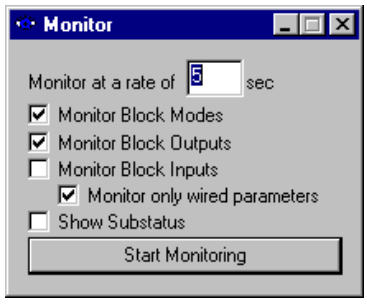
8. If you did not check the **Automatic Mode Handling** checkbox, click **Set All Targets to OOS** to switch the function blocks to OOS mode. After the configuration downloads, you can set the blocks back to their normal mode of operation.

Monitoring a Function Block Application

You can configure how the NI-FBUS Configurator displays the graphical representation of the updates of I/O parameters and mode parameters of function blocks. To do so, complete the following steps:

1. On the Function Block Application Editor toolbar, click the **Monitor** button.

   The **Monitor** window opens.



2. In the **Monitor** window, select the items you want the NI-FBUS Configurator to monitor and display.

3. After you download your configuration, click **Start Monitoring** to monitor the application.

Verifying a Configuration

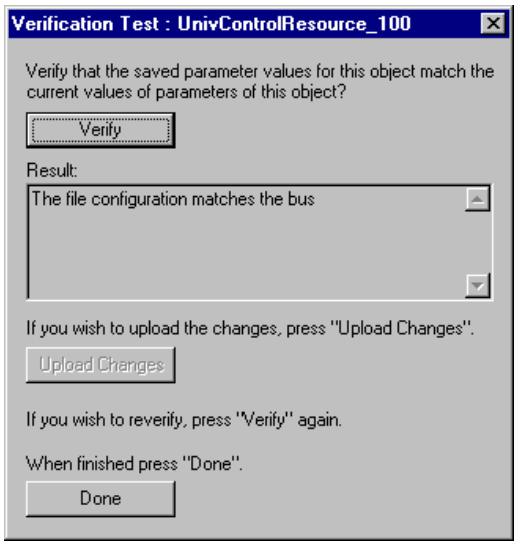
This section describes two ways to verify your configuration: a quick verification and a comparison of the configuration to a saved project.

Quick Verification

You can perform a quick check to verify that the parameters on the bus match those in the project. To verify the configuration of a link, device, or function block, complete the following steps:

1. Right-click the object to display the popup menu and select **Verify Configuration**.

   The **Verification Test** window opens.


Verification Test : UnivControlResource_100
Verify that the saved parameter values for this object match the current values of parameters of this object?
Verify
Result:
The file configuration matches the bus
If you wish to upload the changes, press "Upload Changes".
Upload Changes
If you wish to reverify, press "Verify" again.
When finished press "Done".
Done

2. Click **Verify**.

   The NI-FBUS Configurator compares the function blocks and project settings, and displays the results in the **Result** field.

3. If the function blocks do not match the project settings, you can click **Upload Changes** to upload the function block parameters to the project.

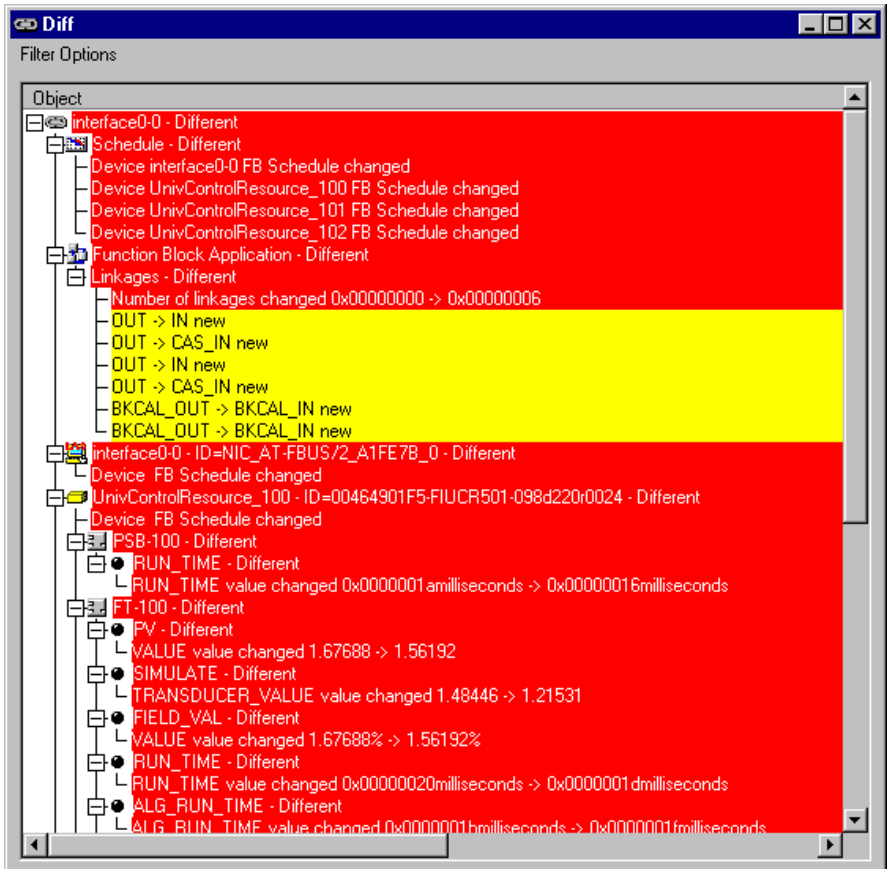
4. Click **Done**.

Comparing Two Configurations

You can upload your current bus configuration and compare it against a saved project. To do so, click the **Verify and Diff** button in the Project window toolbar. You can also select **Configure** ⇒ **Verify and Diff Configuration**.

The NI-FBUS Configurator uploads device parameter values, function block schedules, trend and alarm connections, and function block application linkages, and compares them with the saved configuration. The NI-FBUS Configurator shows which components are different, as shown in Figure 4.17.

Figure 4.17 Diff Window

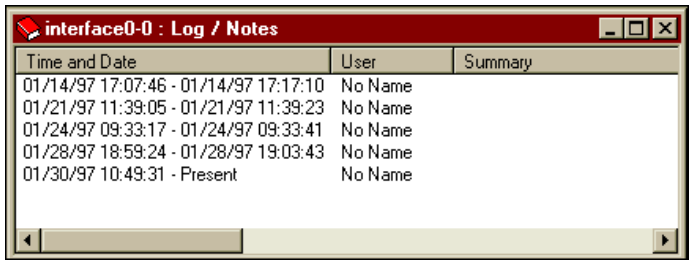

Diff
Filter Options
Object
interface0-0 - Different
Schedule - Different
Device interface0-0 FB Schedule changed
Device UnivControlResource_100 FB Schedule changed
Device UnivControlResource_101 FB Schedule changed
Device UnivControlResource_102 FB Schedule changed
Function Block Application - Different
Linkages - Different
Number of linkages changed 0x00000000 -> 0x00000006
OUT -> IN new
OUT -> CAS_IN new
OUT -> IN new
OUT -> CAS_IN new
BKCAL_OUT -> BKCAL_IN new
BKCAL_OUT -> BKCAL_IN new
interface0-0 - ID=NIC_AT-FBUS/2_A1FE7B_0 - Different
Device FB Schedule changed
UnivControlResource_100 - ID=00464901F5-FIUCR501-098d220r0024 - Different
Device FB Schedule changed
PSB-100 - Different
RUN_TIME - Different
RUN_TIME value changed 0x0000001amilliseconds -> 0x00000016milliseconds
FT-100 - Different
PV - Different
VALUE value changed 1.67688 -> 1.56192
SIMULATE - Different
TRANSDUCER_VALUE value changed 1.48446 -> 1.21531
FIELD_VAL - Different
VALUE value changed 1.67688% -> 1.56192%
RUN_TIME - Different
RUN_TIME value changed 0x00000020milliseconds -> 0x0000001dmilliseconds
ALG_RUN_TIME - Different

Viewing and Editing a Log

The **Log/Notes** window keeps track of the last downloaded configuration status output. The Log/Notes window shows the same output as the Download Log tab of the Status window plus the time and date of the last change and previous downloads of the current project.

To open the Log/Notes window, double-click the **Log/Notes** icon in the Project window. Figure 4.18 shows the Log/Notes window.

Figure 4.18 Log/Notes Window



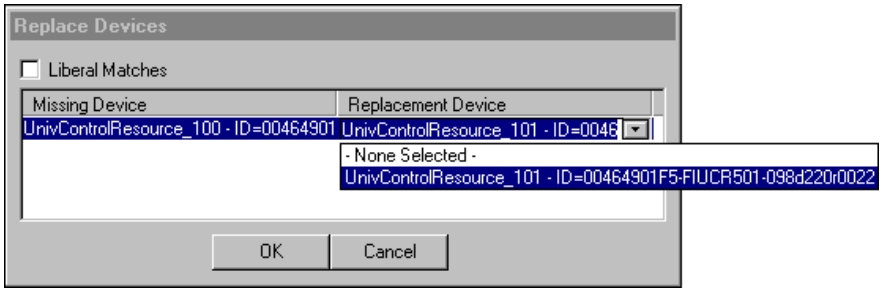
Double-click a log entry to see the download log for that session. You can also add notes at the bottom of the download log for each session, and the NI-FBUS Configurator automatically saves them with the project for future reference.

Replacing Devices

Complete the following steps to substitute a new device for a missing device in the configuration:

1. From the **Configure** menu, select **Replace Devices** or right-click a device and select **Replace Devices** from the popup menu that opens.

2. In the **Missing Device** field, select the device you want to replace from the drop-down list.



3. In the **Correct Device** field, select the new device from the drop-down list to replace the **Missing Device**.

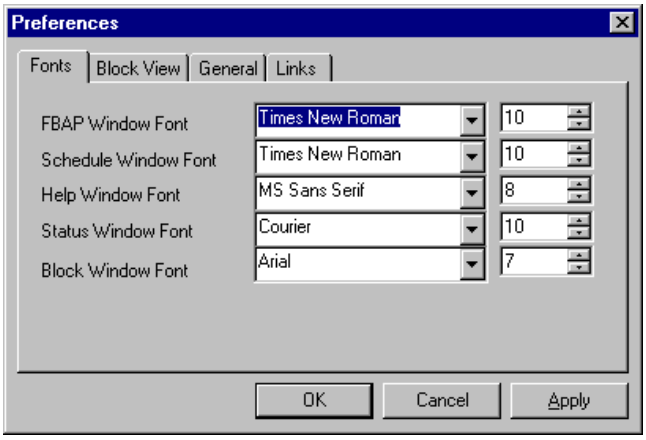
4. After you select the desired devices, click **Done**.

The NI-FBUS Configurator replaces the **Missing Device** with the **Correct Device**. When you download your changes, the new configuration, including linkages, tags, and parameter values, is written to the **Correct Device**.

Setting Preferences

To set your preferences in the NI-FBUS Configurator, select **View** ⇒ **Preferences**.

The **Preferences** window opens.



Descriptions of the tabs follow:

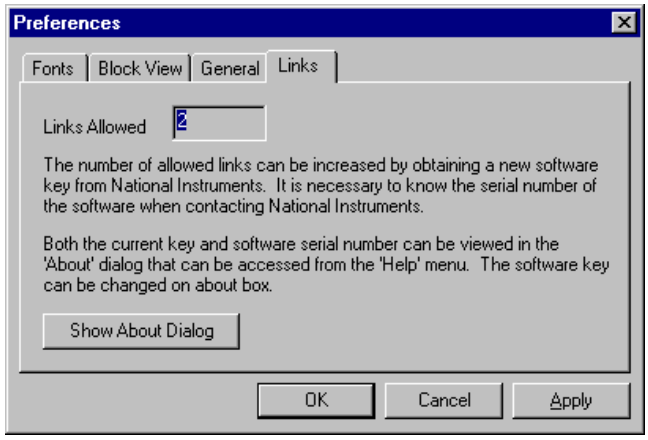
Tab	Description
Fonts	Use this tab to change the font types and sizes on the display.
Parameter Views	Use this tab to configure the default view for parameters: • Show Detailed View–Click this checkbox to show additional type and help strings for the view. • Show Spaced View–Click this checkbox to add space between parameters.
General	Use this tab to select which windows appear when you start the NI-FBUS Configurator.
Links	Use this tab to change the software key, as described in the following section, Changing the Software Key.

Changing the Software Key

The NI-FBUS Configurator software license has a default number of links that you can configure. If you purchase additional licenses to access more than the default number of links, contact National Instruments to obtain a new software key.

After you obtain a new key, complete the following steps to change the key:

1. Select **View** ⇒ **Preferences** and select the **Links** tab.


Preferences
Fonts
Block View
General
Links
Links Allowed
2
The number of allowed links can be increased by obtaining a new software key from National Instruments. It is necessary to know the serial number of the software when contacting National Instruments.
Both the current key and software serial number can be viewed in the 'About' dialog that can be accessed from the 'Help' menu. The software key can be changed on about box.
Show About Dialog
OK
Cancel
Apply

2. Click **Show About Dialog**.

   The **About** window opens.

3. Click **Set SW Key**, enter the new key, and click **OK**.

4. Click **OK** to close the **About** window.

   The number of **Links Allowed** changes based on the new software key.

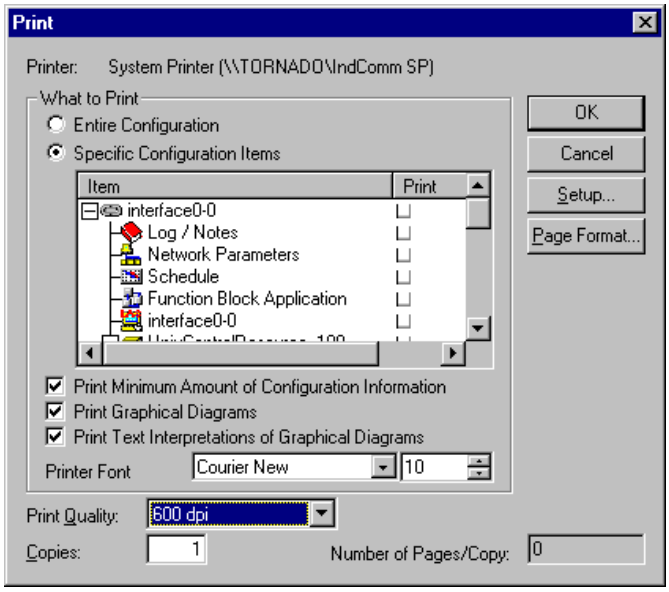
5. Click **OK** to close the **Preferences** window.

Printing

You can print your configured project in the form of text, graphical diagrams, and text explanations of the diagrams.

To print your project, select **File** ⇒ **Print**.

The **Print** window opens.



Under **What to Print**, you can choose to print the **Entire Configuration** or only **Specific Configuration Items**.

Descriptions of the checkboxes in the Print window follow:

Checkbox	Description
Print Minimum Amount of Configuration Information	Click this checkbox to print only the minimum amount of information necessary to describe the printed items. If you check this item, the NI-FBUS Configurator prints only the function blocks that are used in a function block application of the project and does not print unused blocks.
Print Graphical Diagrams	Click this checkbox to print the function block application and graphical representation of the schedule.
Print Text Interpretations of Graphical Diagrams	Click this checkbox to print a text version of the function block application and schedule.

Click **Page Format** to select printing styles for the graphical schematics, page titles, and numbering.

Error Messages and Warnings

This appendix lists error messages you might receive while using the NI-FBUS Configurator and describes the error messages.

Error Messages

If you receive an error message while using the NI-FBUS Configurator, refer to this section for a description of the error and possible solutions.

Error	Possible Solution
NIF_ALARM_ACKNOWLEDGED	The alarm has already been acknowledged.
NIF_BAD_ARGUMENT	The value you gave is not of the correct data type.
NIF_BAD_DEVICE_DATA	The device returned inconsistent information.
NIF_BUF_TOO_SMALL	The buffer does not contain enough entries to hold all the information for the blocks. If you receive this error, buffer entries that you allocated did not contain valid block information when the call returned.
NIF_COMM_ERROR	An error occurred when NI-FBUS tried to communicate with the device.
NIF_CONFIG_ERROR	Some configuration information, such as Windows registry information or network configuration information, is incorrect.
NIF_DATA_NEVER_WRITABLE	The specified object is read-only.
NIF_DEVICE_NOT_PRESENT	The requested device is not operational.
NIF_EXCEED_LIMIT	The device reported that the value exceeds the allowable limit during a write operation.
NIF_INVALID_DESCRIPTOR	The descriptor you gave is invalid.
NIF_MULTIPLE	There are duplicate block tags.
NIF_NOT_FOUND	NI-FBUS could not find the specified object.
NIF_OBJECT_ACCESS_DENIED	The fieldbus interface does not have the required privileges. The access group you belong to is not allowed to acknowledge the event, or the password you entered is incorrect.
NIF_OBJECT_ACCESS_UNSUPPORTED	The device does not support write access to this object.
NIF_OBSOLETE_DESC	The input descriptor is no longer valid. It was closed before a function completed.
NIF_ORDINAL_NUM_OUT_OF_RANGE	The ordinal number is out of the device's range.
NIF_PARAMETER_CHECK	The device reported a violation of parameter-specific checks.
NIF_RESOURCES	NI-FBUS is unable to allocate some system resource; this is usually a memory problem.
NIF_SERVER_CONNECTION_LOST	The session established with NI-FBUS for this descriptor has been closed or lost.

Error	Possible Solution
NIF_SERVER_NOT_RESPONDING	Either the NI-FBUS server has not been started, or the server, in its current state, cannot respond to the request.
NIF_SM_NOT_OPERATIONAL	The device is present, but cannot respond because it is at a default address.
NIF_SYMBOL_FILE_NOT_FOUND	NI-FBUS could not find the symbol file.
NIF_TIMEOUT	The device containing the object is present but did not respond within the timeout period.
NIF_WRITE_IS_PROHIBITED	The device reported that the WRITE_LOCK parameter value is set. The WRITE_LOCK parameter prohibits writing to the name parameter.
NIF_WRONG_MODE_FOR_REQUEST	The device reported that the current function block mode does not allow you to write to the parameter.
NIFCONF_ERR_ADDRESS_OUT_OF_RANGE	This address does not fit in the allowable range of addresses.
NIFCONF_ERR_ADDRESS_USED	This address is already taken.
NIFCONF_ERR_BAD_WIRE	This wire is not completely attached to an output and input(s).
NIFCONF_ERR_BLOCK_SCHEDULE_CONFLICT	A block in this device is already scheduled for this time. Do not schedule more than one block in the device at the same time.
NIFCONF_ERR_BUF_TOO_SMALL	The buffer is too small.
NIFCONF_ERR_CONFIGURING	You are configuring this project. If you get this error, stop configuring the project to continue.
NIFCONF_ERR_CONFUSED_WIRE	This wire is not working. The NI-FBUS Configurator has removed it.
NIFCONF_ERR_CORRUPT_FILE	The NI-FBUS Configurator found a corrupt file object.
NIFCONF_ERR_COULD_NOT_DETERMINE_SCHEDULE	The NI-FBUS Configurator cannot fit the schedule of the loop into the current schedule. Usually, insufficient time or poor choice of loop times cause this error. Use integer multiples such as 1, 2, 4, and so on, instead of multiples like 5, 7, 13, and so on, to solve this problem.
NIFCONF_ERR_COULD_NOT_START_THREAD	The NI-FBUS Configurator is unable to start a new thread.
NIFCONF_ERR_DD_SIZE_MISMATCH	The actual data size does not match the DD data size.
NIFCONF_ERR_DEVICE_NOT_ALIVE	The device is not responding.
NIFCONF_ERR_DOWNLOAD_INCOMPLETE	The link is only partially configured.
NIFCONF_ERR_DUPLICATE_ADDRESS	The address for this device was found elsewhere in the configuration file. Duplicate addresses are not allowed on a fieldbus link.
NIFCONF_ERR_DUPLICATE_TAG	The tag for this object was found elsewhere in the configuration file. Duplicate tags are not allowed on a fieldbus link.
NIFCONF_ERR_INCOMPATIBLE_VERSION	This file was made with a newer version of the NI-FBUS Configurator. There might be unpredictable problems with the project.
NIFCONF_ERR_INVALID_MACROCYCLE	This macrocycle conflicts with a previously defined macrocycle.
NIFCONF_ERR_INVALID_NUMBER	This is an invalid number. A number can use the digits 0-9 and the letters a-f. Hexadecimal numbers can be preceded with `0x`.
NIFCONF_ERR_INVALID_TAG	This tag is not valid.
NIFCONF_ERR_INVALID_VALUE	You have entered an incorrect value. Please check the value(s) and the valid ranges for the values.
NIFCONF_ERR_LOOP_IS_EMPTY	This loop does not contain any blocks.

Error	Possible Solution
NIFCONF_ERR_MACROCYCLE_CONFLICT	This macrocycle conflicts with a previously defined macrocycle time for a device in this loop. Devices can only schedule one macrocycle time. The best solution is to increase the macrocycle time of the loop that contains the other block(s) for this device.
NIFCONF_ERR_MACROCYCLE_NOT_GOOD_MULTIPLE	This macrocycle is a bad choice in comparison to the other macrocycles.
NIFCONF_ERR_MACROCYCLE_TOO_SHORT	There was not enough time in this macrocycle to schedule all the function blocks and parameters. Increase the macrocycle time of the loop to get more free time.
NIFCONF_ERR_MAXIMUM_LOOPS_EXCEEDED	The maximum number of loops that you can configure on this link has been exceeded.
NIFCONF_ERR_MISSING_NIFBUS_PATH	The install path for NI-FBUS Configurator is not in the Windows registry.
NIFCONF_ERR_MULTI_LAS	Multiple primary Link Active Schedulers are defined. Only one primary LAS is allowed on a link.
NIFCONF_ERR_MULTI_TM	Multiple time masters are defined. Only one time master per link is allowed.
NIFCONF_ERR_NO_CONVERSION	There is no conversion for this data type.
NIFCONF_ERR_NO_DATA	No data.
NIFCONF_ERR_NO_LAS_SELECTED	A schedule has been created but no LAS is selected.
NIFCONF_ERR_NO_LM_SELECTED	A schedule has been created but no link master is selected.
NIFCONF_ERR_NO_OBJECT_SELECTED	Nothing is selected.
NIFCONF_ERR_NO_PRINTER_DEVICE_CONTEXT	The NI-FBUS Configurator cannot draw the document because of an incorrect device context for the selected printer.
NIFCONF_ERR_NO_TM_SELECTED	No time master is selected.
NIFCONF_ERR_NO_UNSCHEDULED_TIME_LEFT	The auto scheduler ran out of unscheduled time. Increase the macrocycle time(s) to allow more free time for scheduling.
NIFCONF_ERR_NOT_ON_LINK	This object does not belong on this link.
NIFCONF_ERR_OD_SIZE_MISMATCH	The size of the actual data object does not match the object dictionary (OD) size.
NIFCONF_ERR_OUT_OF_MEMORY	Memory is low; the NI-FBUS Configurator cannot allocate objects. Close windows to solve this problem.
NIFCONF_ERR_PARAMETER_SCHEDULE_CONFLICT	A parameter communication has already been scheduled for this time. Do not schedule more than one parameter communication at a time on the fieldbus.
NIFCONF_ERR_REGISTRY_ERROR	Some registry information for your application is missing or corrupt. You might need to reinstall the NI-FBUS software and the NI-FBUS Configurator. Refer to your getting started manual for installation instructions.
NIFCONF_ERR_STANDARD_DD_MISSING	The NI-FBUS Configurator could not find the standard DD file.
NIFCONF_ERR_STRING_NOT_FOUND	There is a missing resource string.
NIFCONF_ERR_TEMPLATE_NOT_ASSIGNED	The template is not assigned to a valid project object.
NIFCONF_ERR_TOO_MANY_FB_SCHEDULE_ENTRIES	The schedule for this object contains too many entries for the function block schedule of the device. Normally, bad choices for macrocycle times cause this error. Use macrocycle times that are integer multiples of each other to correct this problem.

Error	Possible Solution
NIFCONF_ERR_TOO_MANY_LAS_SCHEDULE_ENTRIES	The number of LAS schedule entries exceeds the number of available entries in the LAS device. Choose integer multiple macrocycle values and reduce the number of data links that go between devices to correct this problem.
NIFCONF_ERR_TYPE_INFO_UNAVAILABLE	The NI-FBUS Configurator cannot read the type information for the object.
NIFCONF_ERR_UNSCHEDULED_TRAFFIC_CONFLICT	The publish time is conflicting with the reserved 128 octet time at the end of a macrocycle. This time is used for unscheduled traffic.
NIFCONF_ERR_WRONG_TYPE	This object has the wrong type.

Warnings

If you receive a warning while using the NI-FBUS Configurator, refer to this section for a description of the warning and possible solutions.

Warning	Possible Solution
NIFCONF_WARN_MEMORY_LOW	The system is low on memory.
NIFCONF_WARN_OBJECT_NOT_WIRED	This object is not connected by wires to any other object.
NIFCONF_WARN_NO_TREND_SELECTED	A trend is wired, but no trend is checked.
NIFCONF_WARN_TREND_NOT_WIRED	A trend is selected, but not wired to a device.
NIFCONF_WARN_PROJECT_ERRORS	There are errors that might cause problems in the download of the configuration. Look at the Errors tab in the Status window.

Troubleshooting and Common Questions

This appendix describes how to troubleshoot problems and answers some common questions.

To determine how to solve a problem, refer to Table 2.1.

Table 2.1 Troubleshooting Problems

Problem	Possible Causes	Solution
A function block alternates between IMAN and AUTO modes. The status of the input parameter is Bad::No comm.	The function block and communication schedules do not have enough time between them.	Refer to Mode Transition on page B-4.
The PID does not transition to AUTO mode.	The status of **OUT/BKCAL_OUT** from AI/AO is Bad::Not Connected or Bad::No Comm.	Refer to Mode Transition on page B-4.
	The downstream block is not in cascade mode.	
The AI does not transition to AUTO mode from OOS mode.	The configuration is incorrect or incomplete.	Refer to Mode Transition on page B-4.
The function blocks are in OOS mode.	The resource block is in OOS mode.	Set the target mode of the resource block to **AUTO**.
You receive a status of Bad:Device Failure.	An error exists with the hardware.	Set the **RESTART** parameter in the Block window to **Processor** or **Default**. If the problem persists, replace the device.
A device does not appear in the Project window.	The communication parameters are incorrect.	Refer to Missing Devices on page B-3.
You are unable to write to a block parameter.	The parameter is read-only.	If the parameter is not read-only, refer to the Reading and Writing Errors on page B-5.
	The blocks are in an incorrect mode.	
	The data is out of range.	
A device does not accept a permanent address.	The device does not have a tag.	You must set the device tag. For instructions on setting the tag, refer to the Setting Device or Block Tags section on page 4-5.
	If the device already has a tag, the T3 network parameter might not be the right length.	Remove the device from the active bus and configure its address separately.
A device does not accept a new tag.	The device is in an invalid state.	Power the device off and on.
The control is slow.	The macrocycle time might be too long.	Edit the function block schedule and decrease the macrocycle time. For more information about editing the schedule, refer to the Viewing and Editing Function Block Parameters section on page 4-19.
A device does not transmit alarms or trends.	You have not configured the alarms or trends.	For instructions on how to configure alarms and trends, refer to the Configuring Alarms and Configuring Trends sections on pages 4-25 and 4-26, respectively.

Table 2.1 Troubleshooting Problems (Continued)

Problem	Possible Causes	Solution
A device does not publish the data you configured it to transmit.	The function execution time parameter in the function block does not accurately represent the execution time.	Refer to the Transmission Problems section on page B-4.
Your interface(s) does not appear in the **Add Links** dialog box.	You may need to upgrade your software key to support the additional links.	Refer to the Missing Interface section on page B-2.
A function block is missing symbolic information (such as names and help strings).	The function block has no DD, and the block does not correspond to the standard function blocks defined by FOUNDATION Fieldbus.	You may need to import the DDs. To do so, refer to the Missing Symbolic Information on page B-2.
	The NI-FBUS Configurator cannot read pertinent block information from the device.	Reset the device.
You receive frequent communication errors when you try to read or write to a device.	Other devices are actively and frequently polling the device, causing reads to time out.	Reduce polling.
	The device is in an invalid state.	Reset the device.

Troubleshooting

This section describes how to troubleshoot problems you might encounter while using the NI-FBUS Configurator.

Missing Interface

If your interface(s) does not appear in the **Add Links** dialog box, you may need to upgrade your software key to support the additional links.

If you purchased additional licenses to access more than the default number of links, contact National Instruments to obtain a new software key.

After you obtain a new key, complete the steps on page 4-37 to change your software key.

Missing Symbolic Information

If a function block is missing symbolic information (such as names and help strings), you may need to import the Device Descriptions (DDs). For more information about importing DD files, refer to the Importing Device Description Files section on page 4-4.

If the problem persists after you import the DDs, reset the device.

Device Problems

If you receive a status of **Bad:Device Failure**, set the **RESTART** parameter in the Block window to **Processor** or **Default**. If the problem persists, replace the device.

If a device does not accept a permanent address, you must set the device tag. For instructions on setting the tag, refer to the Setting Device or Block Tags on page 4-5. If the device already has a tag, the T3 network parameter might not be the right length. To solve this problem, remove the device from the active bus and configure its address separately.

If a device does not accept a new tag, it might be in an invalid state. To solve this problem, power the device off and on.

Missing Devices

If a device does not appear in the Project window, complete these steps:

1. Check all connections.
2. Power on the bus.
3. Select **Start** ⇒ **Programs** ⇒ **NI-FBUS** ⇒ **Interface Config** and click on the **Advanced** button.
4. Set the following parameter values.

Parameter	Value
Number of unavailable nodes	0
InterPduDelay	20
Slot time	10
Max reply delay	8

5. Select **Start** ⇒ **Programs** ⇒ **NIFBUS** ⇒ **nifb** to restart the nifb process.
6. Select **Start** ⇒ **Programs** ⇒ **NIFBUS** ⇒ **NI-FBUS Configurator** to restart the NI-FBUS Configurator.

Transmission Problems

If a device does not transmit alarms or trends, you have not configured them yet. For instructions on how to configure alarms and trends, refer to the Configuring Alarms and Configuring Trends sections on pages 4-25 and 4-26, respectively.

If a device does not publish the data you configured it to transmit, complete these steps:

1. Edit the schedule to add more time to the communication schedule. To edit the schedule, double-click the **Schedule** icon in the Project window.

   For more information about editing the schedule, refer to the Viewing and Editing a Schedule section on page 4-27.

2. If your project reads and polls information continuously, turn off polling to see if the device publishes the data. To turn off polling, uncheck the **Periodic Updates** checkbox at the top of the Block window.

Mode Transition

If a function block alternates between IMAN and AUTO modes, your function block and communication schedules do not have enough time between them. To solve this problem, complete these steps:

1. Edit the schedule to add more time between the function block and communication schedules.

   For information about editing the schedule, refer to the Viewing and Editing a Schedule section on page 4-27.

2. After you edit the schedule, select **Configure** ⇒ **Download Configuration** to download the changes.

   For information about downloading the configuration, refer to the Downloading a Configuration section on page 4-31.

If the PID does not transition to AUTO mode, complete these steps:

1. Make sure that the AI and AO are publishing.
2. Make sure that the LAS executes the communication schedule. If not, select **Configure ⇒ Download Configuration** to download the configuration.

   For information about downloading the configuration, refer to the Downloading a Configuration section on page 4-31.
3. Make sure the target mode of the downstream block is set to **CAS**.

If the AI does not transition to AUTO mode from OOS mode, complete these steps:

1. Make sure the target mode is set to **AUTO**.
2. Make sure **EU_UNITS** is set to the value specified by the vendor.

If the function blocks are in OOS mode, set the target mode of the resource block to **AUTO**.

Reading and Writing Errors

If you are unable to write to a block parameter, the parameter might be read-only. However, if the parameter is not read-only, complete the following steps to solve the problem:

1. Change the target mode to **MAN** or **OOS** and then try to write to the parameter.
2. Check the range and make sure the value is not out of range.

If you receive frequent communication errors when you try to read or write to a device, reduce polling. If the problem persists, reset the device.

Common Questions

How can I speed up the control?

If the control is slow, the macrocycle time might be too long. To speed up the control, edit the function block schedule and decrease the macrocycle time.

For more information about editing the schedule, refer to the Viewing and Editing a Schedule section on page 4-27.

Why is my interface missing from the Add Links dialog box?

If your interface(s) does not appear in the **Add Links** dialog box, you may need to upgrade your software key to support the additional links.

If you purchased additional licenses to access more than the default number of links, contact National Instruments to obtain a new software key.

After you obtain a new key, complete the steps on page 4-37 to change your software key.

We use these abbreviations, acronmys, and initialisms throughout the document.

Term	Definition
AI	Analog Input
AO	Analog Output
basic device	a device that can communicate on the fieldbus, but cannot become the LAS
BG	Bias Gain
block	A logical software unit that makes up one named copy of a block and the associated parameters its block type specifies. The values of the parameters persist from one invocation of the block to the next. It can be a resource block, transducer block, or function block residing within a VFD.
block tag	a character string name that uniquely identifies a block on a fieldbus network
bridge	an interface in a fieldbus network between two different protocols
contained parameter	a parameter that does not receive or send data, and is contained within a function block
control loop	a set of connections between blocks used to perform a control algorithm
control strategy	*see* function block application
CS	Control Selector
DCS	Distributed Control System
DD	Device Description
deterministic	communication in which data is transferred between a given set of
communication	devices at the same time during each loop
device ID	An identifier for a device that the manufacturer assigns. Device IDs must be unique to the device; no two devices can have the same device ID.
device tag	a name you assign to a fieldbus device
DI	Discrete Input
DO	Discrete Output
FBAP	*see* function block application
fieldbus	an all-digital, two-way communication system that connects control systems to instrumentation
Fieldbus Foundation	the organization that developed a fieldbus network specifically based upon the work and principles of the ISA/IEC standards committees
FOUNDATION Fieldbus	the communications network that the Fieldbus Foundation created

Term	Definition
function block	A named block consisting of one or more input, output, and contained parameters. The block performs some control function as its algorithm. Function blocks are the core components you control a system with. The Fieldbus Foundation defines standard sets of function blocks. There are ten function blocks for the most basic control and I/O functions.
function block	a fieldbus application that you create using FOUNDATION Fieldbus application
IEC	International Electrotechnical Commission. A technical standards committee which is at the same level as the ISO.
input parameter	a block parameter that receives data from another block
ISA	International Society for Measurement and Control
LAS	*see* Link Active Scheduler
link	a group of fieldbus devices connected across a single wire pair with no intervening bridges
Link Active Schedule	a schedule of times in the macrocycle when devices must publish their output values on the fieldbus
Link Active	A device that is responsible for keeping a link operational. The LAS
Scheduler	executes the link schedule, circulates tokens, distributes time and probes for new devices.
Link master device	a device that is capable of becoming the LAS
linkage	a connection between function blocks
loop	*see* control loop
m	Prefix meaning *milli-* and has a value of 10^{-3}
macrocycle	the least common multiple of all the loop times on a given link
ML	Manual Loader
OD	object dictionary
OOS	out of service
output parameter	a block parameter that sends data to another block
PD	Proportional Derivative
PID	Proportional Integral Derivative
RC	Ratio Control
s	seconds

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